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(See page 184.)

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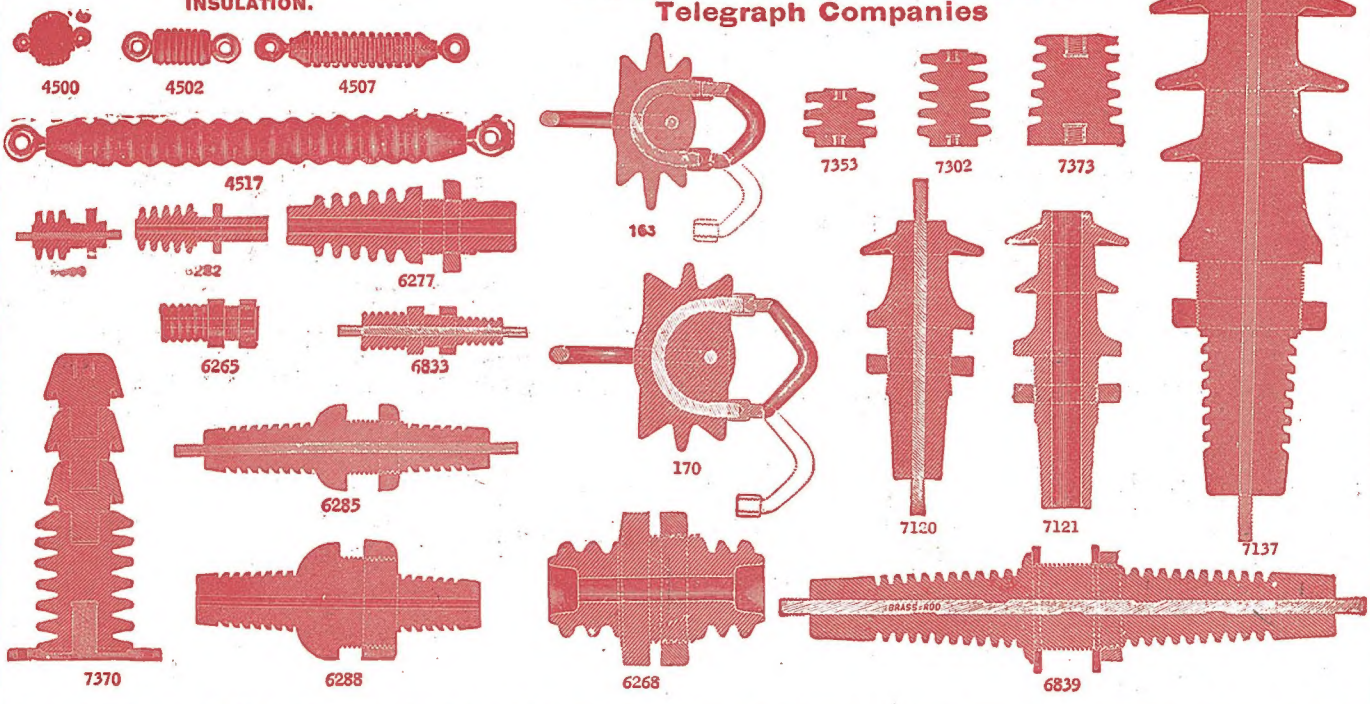

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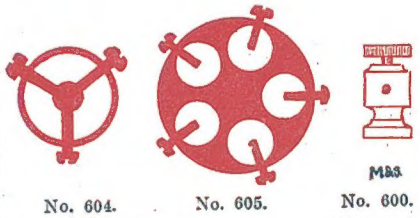

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Uncle Sam and the Inventor

AT last the American inventor is coming into his own. Our Government, which heretofore has paid but scant attention to the activities of our inventors and experimenters, is beginning to recognize that there are a few persons outside of the Department who know a thing or two.

The courageous action of Secretary of War Daniels in organizing a board composed of the foremost American inventors cannot be lauded too highly. Mr. Edison has already accepted enthusiastically Mr. Daniels' invitation as chairman of the new Advisory Board, and no doubt we will soon witness valuable additions in the persons of famous inventors like Orville Wright, Henry Ford, John Hays Hammond, Jr., Tesla, Bell, Steinmetz and others.

This board of famous civilian experimenters will be known as the *Naval Advisory Board* and will have the sole purpose of strengthening our weak national defenses by means of new inventions. The European war has amply shown that battles are no longer won by means of men and guns alone. Never before have scientists won as many battles as now; never before have battles been so deadly as now, due entirely to science let loose on the enemy. As Secretary Daniels states:

"One chemist, one electrician might be greater in the warfare of the future than Napoleon, at his best, was in the warfare of the past. One scientist very probably may do more for the United States than any admiral or general could do."

Frightful? Of course. What otherwise can be expected of poisonous gases, electrically charged wires, land and sea mines, bomb-throwing aeroplanes, murderous submarines, and poisonous shells? But then, all warfare is frightful. Once you have been killed, it does not matter whether the ancient sword of a Roman pierced your heart or a modern poisonous gas snuffed out your life. The sole business of war is to kill, and the more frightful and the more terrible our scientists can make war, the better for us.

For it must not be forgotten that, once we arrive at a stage where we are able to annihilate a whole regiment at one stroke, there will be no more wars. People will then think for a long time before engaging in foolish wars, and once people begin to coolly consider, the danger of war is well nigh passed.

As a democratic nation we do not believe in a big standing army, indeed the more the world advances in scientific warfare, the less men do we need to defend a given line. Already the common soldier with his rifle is an anachronism. His rifle is of but little use to him to-day and is fast disappearing. Two men behind a machine gun can hold 500 soldiers with rifles at bay with ease, while in trench warfare the rifle becomes an actual hindrance. Future wars will be machines against machines, far more so than to-day, while the common soldier of the present will man the machines. Land battles will be fought so far apart that men will no longer be able to see each other, as is the case in the present naval warfare, where the battling dreadnoughts are actually shelling each other with nothing but their mastheads showing above the horizon.

Undoubtedly many an American inventor has been bitterly disappointed in the past for not having his invention recognized, or else not having the means, financial or otherwise, to try out his idea in actual practise. This the new board will remedy. The poorest inventor with a good idea will now have his chance to submit it to a board of men who are not to be influenced in the slightest by financial or other considerations. He will get frank and expert advice, which he probably could not obtain anywhere else in the world—and the advice will not cost him a single penny. If his idea is good, he will be told so. If it is not good, he will know that he is on the wrong track, for the men that tell him so are not theorizers, but practical inventors and experimenters, whose opinions can safely be relied upon in all cases.

It behooves us to applaud Secretary Daniels for his momentous innovation and we furthermore sincerely hope that American genius will succeed in making wars so terribly frightful and so deadly that there will not be a "next war."

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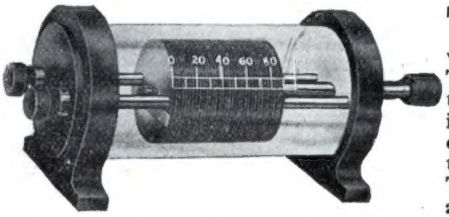

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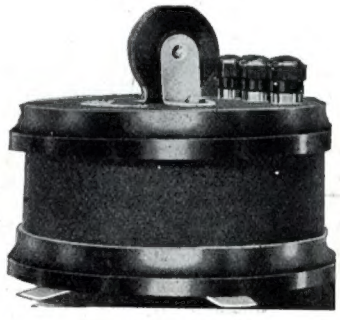

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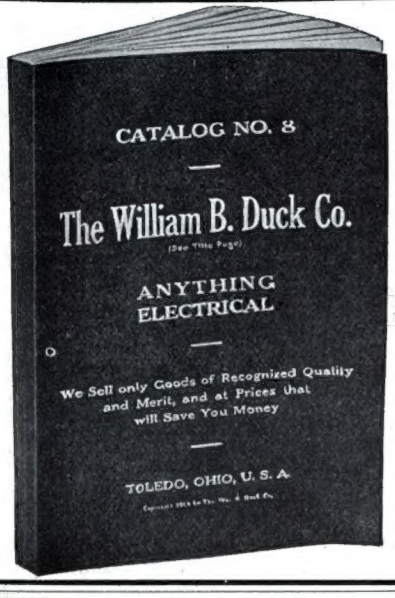
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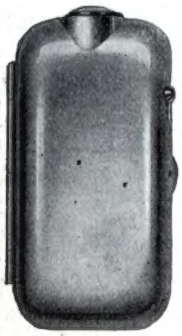

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THE ELECTRICAL EXPERIMENTER

Vol. III. Whole No. 29 SEPTEMBER, 1915 Number 5

The Wonders of Radium

RADIUM! A thousand years hence a benevolent smile will pass over the features of the average planet inhabitant when he thinks back upon the time when science was still grappling with the mysteries of Radium, the wondrous. It will no doubt seem strange to him how the world could have gotten along for centuries without having subjugated nature's forces to his entire advantage, as he will do then. He will pity us for having lived in a dark age, and his pity for us will be on par with that we now have for the Dark Ages, when man still made the cave his abode.

We are accustomed to think of electricity as being a wonderful power. Indeed, it has revolutionized our lives completely. It might be said that up to the 19th. century, that is, before the advent of electricity, man was still uncivilized. We might even go so far as saying that the new civilization period dates back to the year 1791, when Galvani first made his memorable experiment with the frog, incidentally discovering "Galvanic" electricity.

But the wonders of electricity, as we are accustomed to them to-day, are naught when we contemplate the marvels that lay before us when man will finally understand atomic forces. Every particle of matter has concealed within itself undreamt of forces which at present are locked up and are inaccessible to man. Once we are enabled to unlock these forces, the proverbial "Aladdin's Lamp" will grow pale by comparison.

Is Radium the key that will open the door to the Promised Land? What is Radium? What are its functions? Wherein does it differ from a piece of stone? The average man does not seem to know; indeed, it is amazing to find how much ignorance there is displayed at this minute as to what Radium really is and does. The layman has the most astonishing conception about this wonderful element, and the wildest prophecies and guesses are made by people who have a good general knowledge of everyday science.

The purpose of this article is to set forth in a popular manner the wonders and the astounding possibilities of Radium in a non-technical manner as far as that is possible.

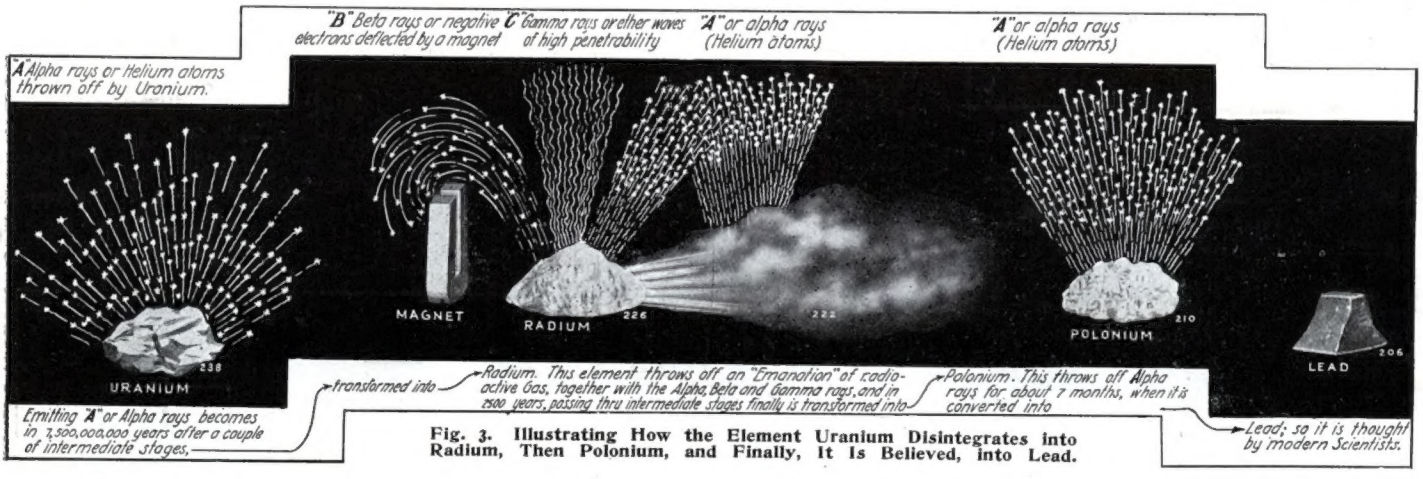
"B" Beta rays or negative electrons deflected by a magnet
"C" Gamma rays or ether waves of high penetrability
"A" or alpha rays (Helium atoms)
"A" or alpha rays (Helium atoms)
"A" Alpha rays or Helium atoms thrown off by Uranium.
MAGNET
RADIUM
226
222
POLONIUM
210
URANIUM
238
LEAD
206
Emitting "A" or Alpha rays becomes in 7,500,000,000 years after a couple of intermediate stages,
transformed into
Radium. This element throws off an "Emanation" of radio-active Gas, together with the Alpha, Beta and Gamma rays, and in 2500 years, passing thru intermediate stages finally is transformed into
Polonium. This throws off Alpha rays for about 7 months, when it is converted into
Lead; so it is thought by modern Scientists.

Fig. 3. Illustrating How the Element Uranium Disintegrates into Radium, Then Polonium, and Finally, It Is Believed, into Lead.

IN this prosaic age we are prone to scoff at miracles; we only think of them as the foolish misconceptions of a bygone age. But the most impossible miracles of the past pale into insignificance alongside of Radium, the miraculous. Who could have predicted 20 years ago that 1/50 gram of a new element—Radium—could supply sufficient energy to lift the Woolworth building bodily into the air? Where is the bold prophet who can predict the still greater miracles in store for man? Radium is the key that will open the door to man's final emancipation. This article explains its wonders in a non-technical manner.

History of Radium.

Prof. Henri Becquerel, the famous French physicist, in 1896, while experimenting with the then newly discovered X-rays, wondered if it were not possible to procure a substance that would give off rays similar to X-rays. After numerous and painstaking experiments, he found that his surmise was correct, and he found that the element Uranium was indeed capable of giving forth rays similar to X-rays, without in any way being under the influence or connected to any electrical or other source of power. In other words, he found that Uranium gave off a spontaneous and continuous stream of rays, without seemingly disintegrating while it was doing so. A homely comparison will not be amiss here.

Suppose we have an automobile tire well compressed with air. It would be reasoned that in case of a minute puncture the air

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will leak out quickly, the tire becoming flat, after the accumulated air has left it. This is a comparison of the X-ray, i. e., the X-ray tube gives forth X-rays only as long as it is connected to an electric transformer. Now, Uranium acts like a tire that has a puncture, but notwithstanding this it does not become "empty." Of course Uranium, the same as any other natural force, will "give out" finally, but it has been calculated that it will take some 7,500,000,000 years before it ceases to be "active."

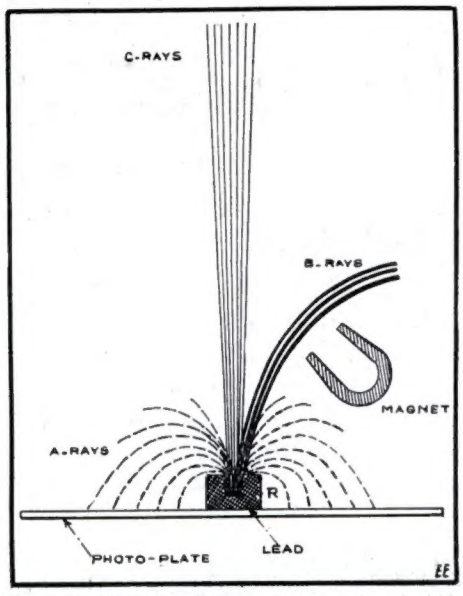


Fig. 1. Showing Effect of Magnet on the "Alpha" and "Beta" Rays.

After Prof. Becquerel had published his reports on Uranium, M. and Mme. Curie, of France, began their wonderful researches independently from Becquerel, and in the course of their tremendous labors discovered Radium and then Polonium.

So far, the element Radium, which we believe to be a metal, has not been isolated in its metallic form. At present we only know Radium Chloride and Radium bromide. We have already, however, ascertained the atomic weight of Radium, which we know to be 236, while Uranium has an atomic weight of 238, while the metal closest related to Radium, namely, lead, has an atomic weight of 206.

Wonderful Properties of Radium.

Let us first enumerate the properties of Radium and wherein it differs from other substances.

If we take a piece of lead, the only remarkable physical properties which we can discover about it is that it is very heavy and that it melts rather easily. If we view it in the dark, nothing can be seen. If we place it on a photographic plate, nothing happens. If we bring it near an electroscope—an instrument which records electrical charges in its neighborhood—the result will be negative.

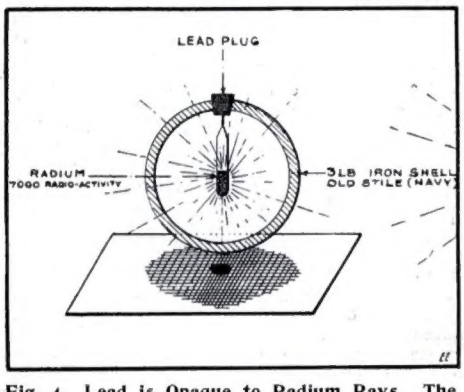


Fig. 4. Lead is Opaque to Radium Rays. The Lead Plug in an Iron Cannon Ball Shows a Black Spot on Photograph as Perceived.

Not so with Radium. If we take a small quantity of Radium salt and place it in a dark room, we will see that it emits a faint glow of light. Place a speck of Radium in front of a fluoroscope, such as is used in X-Ray work, and the screen of the fluoroscope will light up brilliantly, showing the rays to be of a similar nature to that of X-rays.

Indeed, we can prove this by putting our hand on the back of a fluoroscope, placing the Radium behind the hand; if we have a sufficient quantity of Radium, the bones of the hand will be seen clearly outlined on the fluoroscope screen, the same as if X-rays were used.

If we place a speck of Radium on a photographic plate, although the latter is wrapped up in several layers of paper and is placed in a wooden box, the rays of Radium will pass through the box and the paper, blackening the photographic plate.

If we bring Radium near an electroscope, an electrical charge is indicated by the latter immediately, showing that Radium gives off an electrical force.

Radium also gives off what is technically termed as "emanations." Inasmuch as this is a misunderstood term by the average layman, a homely analogy will not be amiss again.

The word "emanation" really means giving off particles of force and matter. The analogy in this case being a garden hose, to the end of which is attached a spraying nozzle. As is well known, the water comes out of this nozzle in very finely divided streams. We can compare Radium to this spray, the emanation being the water as it leaves the spray. But here the analogy ends, as will be seen later.

Radium gives off a number of rays which are invisible to the unaided eye, these rays being termed "emanation," as explained before.

There are three different and distinct types of rays which are known to scientists, respectively, as:

1° Alpha Rays.
2° Beta Rays.
3° Gamma Rays.

The Alpha rays possess certain characteristics of the well-known X-ray, and many have thought these rays to be identical with X-rays, but they do not have any appreciable penetrative power. In fact, they are stopped by a thin layer of air and a piece of paper. They carry with them a positive charge of electricity.

The Beta rays have a much greater penetrative power than the Alpha rays, and the velocity of these rays approaches that of light iself, which is 185,000 miles per second. These rays may be deflected from their original direction by means of a magnet, proving their electrical character. Fig. 1 illustrates this very readily. If we take a piece of lead and bore a small cavity in same, as shown in illustration, and then place a speck or Radium in its cavity, we find that the Alpha rays only make an impression on the photographic plate, as shown. The Beta rays also give off an electrical charge, but unlike the Alpha rays, it is negative, while the former is positive.

The third rays, that is the Gamma rays, possess the greatest penetrative effect of the three. These most powerful rays produce radio-activity through the air for a considerable distance, but they appear not to carry any electrical charge with them, for the reason that they are not influenced by a powerful magnet. That the Alpha and Beta rays carry an electrical charge, or, in other words, give off electricity continuously, is best proven by the following experiment. Refer to Fig. 2.

If we take a gold leaf or aluminum leaf electroscope, as shown at A, and charge it by means of an electrified rod of hard rubber, the two leaves will diverge, as seen. But as soon as any substance containing Radium or pure Radium salts is brought near the electroscope, as shown at B, the leaves will collapse. This action is due to the fact that the rays charge the leaves with opposite electricity, thereby causing them to collapse, again proving Radium to be a body that gives off an electrical charge.

The wonder about Radium, however, is not that it emits these rays and electrical charges, but the mystery so far unsolved is *that it does so continuously and almost indefinitely*, contrary to any other known element so far discovered. In our analogy before we spoke of an automobile tire, if punctured, that never became empty. Exactly so with Radium. It gives off energy without any apparent loss of weight or power or intensity, and while this process seems to go on indefinitely, this really is not the case.

The most remarkable property of Radium, however, is found in its ability to give out a considerable amount of heat without cessation; thus, if a thermometer is placed in a tube containing Radium or Radium salts, and if the thermometer is sealed air-tight to the tube, it will be found that this thermometer always registers a 2.7 degree Fahrenheit higher temperature than the surrounding air.

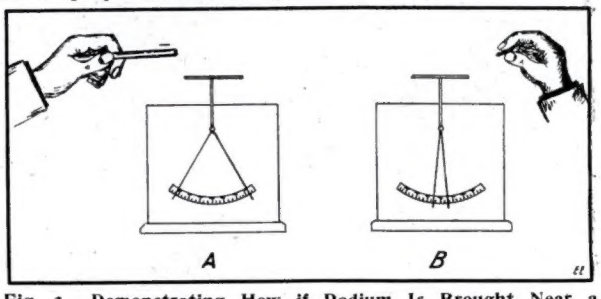


Fig. 2. Demonstrating How if Radium Is Brought Near a Charged Electroscope (A) That It Will Be Discharged (B) Owing to Electronic Rays Shot Off by the Radium.

How immense the energy produced by Radium is may be better understood from the following: *One ounce of Radium will raise one ounce of water from freezing point to boiling point in one hour. And heat continues to be produced at this rate, not for one hour, not for one day, not for one year, but for* 2,500 *years,* before the Radium finally gives out! The greater part of this ponderous energy is produced by the energy of the Alpha particles of the Radium emanation.

A thimbleful of this emanation would contain about seven million calories of heat, sufficient to raise 15,000 pounds of water 1 degree! Weight for weight, the heat evolved by the Radium emanation is nearly one million times greater than that let loose by any known chemical reaction.

Life of Radium.

Prof. Rutherford, who probably to-day is the greatest authority on Radium, has calculated the average life of Radium to be within the limit of twenty-five hundred years. In other words, a given quantity of Radium will furnish energy for twenty-five hundred years without stopping. It is this property which makes Radium so wonderful and so unlike any other substance and element we know. Before Radium was as well understood as it is to-day, it was even thought that we had here an approach to perpetual motion, but we have since learned

that this is not the case. But it is truly remarkable that any substance should be able to give forth such a tremendous power for

Fig. 5. Radium Picture of Mouse. Exposure 24 Hours. Photo Taken by William J. Hammer.

such an exceedingly long time without materially weakening.

However, there is probably something behind this which we have not as yet ascertained. A theory of the writer has long been that Radium is nothing but a form of "sponge" which takes up within itself some unknown to us energy, transforming it into an electrical energy. While this theory has not been proved nor disproved, it opens up a new avenue in research. Undoubtedly, something of this sort must take place, as otherwise Radium would be contrary to almost every rule of the conservation of energy.

Scientists from time immemorable have been trying unsuccessfully to transmute a lower grade metal into one of the higher orders. Thus many of the alchemists have tried to convert lead and other heavy metals into gold, silver and other precious metals, without success. Radium, at last, has given us a means by which this may some day become accomplished. Our Fig. 3 shows graphically how the alchemist's dream has at last come true. Here we see how one element is actually changed into another one. In other words, it shows the transmutation from Uranium to Radium, from Radium to Polonium, and from Polonium finally to Lead. While this has not been conclusively proven so far, the indications are that the sequence as stated above is the correct one, and from this it may be inferred that at some not far distant date it will be possible to change one metal into any other given one.

It is thought by many scientists that Uranium is broken up and disintegrated into Radium, as shown in our Fig. 3, which shows the subjects at which the Alpha rays, Beta rays and Gamma rays are respectively emitted during the break-up, if such really occurs with the so-called Radium atom. While various theories have been brought before the scientific world, none of them has as yet been accepted as final, on account of the different results each observer obtains, and for this reason no final conclusion can be stated here.

As we also stated above, the disintegration of Radium is continuous, and while the average life of Radium has been calculated to be twenty-five hundred years, this, however, is not final and is merely hypothetical.

Various Radium Effects.

Prof. Rutherford, who has conducted a most painstaking investigation into the penetrative character of all the radiations of Radium, Uranium and Thorium, has found that lead was the best insulator for the radio-active rays, and for this reason Radium is always kept in lead cases or lead bottles. Fig. 4 shows this very nicely. Some Radium salt is placed in a glass tube, the latter being attached to a lead plug, and the tube is then inserted in a three-pound iron shell, such as have been used in the past by the navy. If this apparatus is now placed upon a photographic plate, the rays will of course pass through the iron shell, but cannot pass through the lead; the rays will now be reflected from the lead plug and will strike down in the axial direction of the tube. When the photographic plate has been developed, it is found that a picture of the lead plug has been photographed on the plate, simply by reflection. In this case the rays not only penetrated the iron shell, but also the rubber cover which enclosed the photographic plate on which the shell rested. A strong black spot in the center of the picture was the result.

An interesting photograph is shown at Fig. 5, which is a Radium (X-ray) picture of a mouse. This mouse was radiographed in about 24 hours by placing it directly on a photographic plate, six inches above which were supported on a cardboard frame six

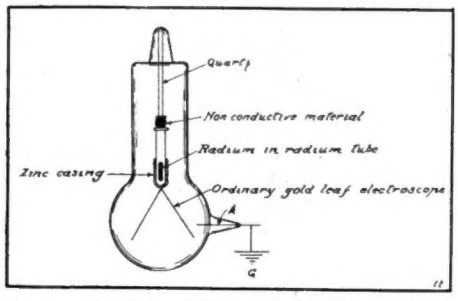


Fig. 7. Radium Will Run This Clock 2,500 Years. The Nearest Approach to Perpetual Motion.

tubes of Radium having the following radio-activities: 40, 100, 250, 1,000, 3,000 and 7,000, as compared with Uranium (the standard). This arrangement was put in the bottom of a trunk, the trays being replaced, and the trunk wrapped in three thick rugs and kept in a dark room. This picture well shows the powerful penetrative power of these wonderful rays.

Fig. 8. Radium Light is Practical, and Actually Permits One to Read 6 Feet Distant From the Bulb.

Besides having all the wonderful properties enumerated above, Radium still has another property, and that is its effect upon man's body. One of the earlier Radium

Fig. 6. Auto-Photograph of Piece of Pitchblende Taken by Its Own Rays.

scientists was carrying a glass tube containing Radium salts in his vest pocket. While there were no bad effects to be perceived, and while the Radium did not seem to do any harm when placed upon the naked skin for a short time, bad burns appeared within a few days, which proved to be exceedingly hard to heal, and produced worse effects than the well-known X-ray burns which many persons experimenting with the latter rays experience.

In connection with this, however, a very curious paradox has been discovered by Dr. Robert Abbe. In a lecture on "X-ray Epithelioma Curable by Radium," Dr. Abbe recently delivered a paper to the *Journal of the American Medical Association.* This scientist claims that by using Radium in a certain manner, these X-ray burns can actually be healed by means of Radium. This seems more proof that the properties of the Radium rays are vastly different to those of X-rays.

As said above, Radium is not without its dangers. It is also very dangerous to the eyes, and if Radium is viewed very closely it may result in ultimate blindness, if the experiment is carried on for any great length of time. In connection with this, a curious fact was found in the following:

If a person is taken into an absolutely dark room, and if a small tube containing a Radium salt is placed directly over the closed eye, a strong sensation of light within the ball of the eye is experienced. Some explanations have been offered as to this result, but none is quite satisfactory.

While Radium is no doubt dangerous, if handled by the layman, the medical profession has already made great use of the mysterious element. It seems that cancer and some other diseases have been actually healed by placing a minute quantity of Radium, sealed in a tube, on top of the sore. Some physicians have even gone as far as to open cancers and placing a very small tube in the inside of the diseased flesh, and in many cases a permanent cure has been the result. In case of cancer of the stomach the patient has been made to swallow a small glass vial containing a very minute quantity of Radium salt, thereby bringing the latter in close contact to the cancer, and in this case also many cures have resulted.

Of course such experiments must be carried out very carefully, and it is especially the quantity of the Radium salt that is important, for if too much is used disastrous results will be experienced.

Of course, we are but at the beginning, and more wonders and cures are to be expected by the direct application of Radium.

A curious experiment was performed by Mr. William J. Hammer, the well-known experimenter, who several years ago visited the aquarium of Naples, Italy. This aquarium has a large collection of electric fishes, and Mr. Hammer experimented with the *Torpedo Galvani* and the *Gymnotus Electricus*. As is well known, these fishes are capable of dealing a very powerful electric shock, if the bare hand is brought in contact with the body of the fish. The shock, in some cases, has been strong enough to kill a grown man. Mr. Hammer, who had obtained several tubes of Radium from the Curies, of Paris, placed these tubes directly upon the body of the fish. The tubes were left for some 20 minutes in contact with the fish's body, and it was found that the Radium emanations had entirely dissipated the fish's electrical charge and the animal was no longer capable of giving electrical shocks for quite a time.

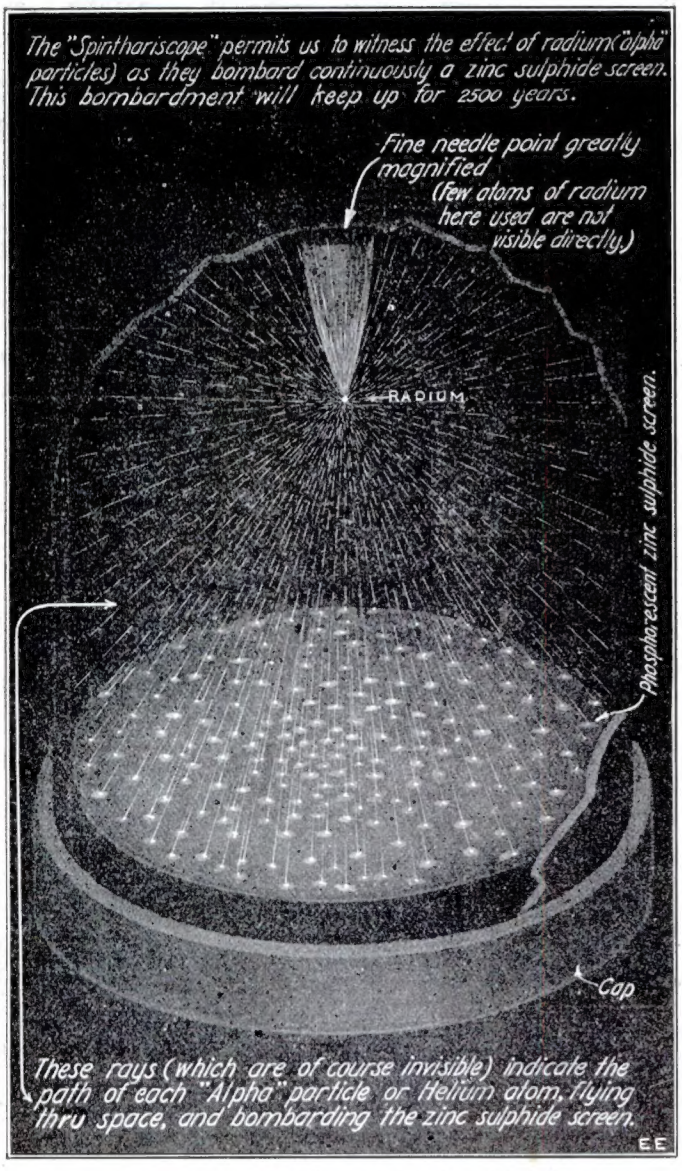

The "Spinthariscope" permits us to witness the effect of radium ("alpha" particles) as they bombard continuously a zinc sulphide screen. This bombardment will keep up for 2500 years.
Fine needle point greatly magnified (few atoms of radium here used are not visible directly)
RADIUM
Phosphorescent zinc sulphide screen.
Cap
These rays (which are of course invisible) indicate the path of each "Alpha" particle or Helium atom, flying thru space, and bombarding the zinc sulphide screen.
E.E.

Fig. 11. Magnified Sectional View of Interior of Spinthariscope.

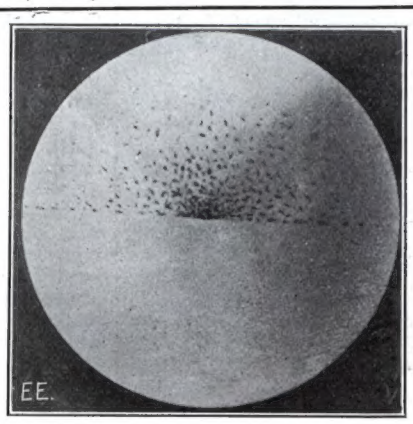


Fig. 10. View Through Eye-Piece of Actual Spinthariscope.

Radium Supply of the World.

There is but very little Radium in the hands of man to-day. By this we mean that only about one pound of Radium or Radium salts is actually in use, for the reason that Radium is one of the most difficult substances that can be obtained. At the present time almost our entire supply is obtained from Austria, from the mineral called "Pitchblende," and this form of pitch is highly charged with various Radium salts. There is only one part of the element Radium for every 3,200,000 parts of the element Uranium in Pitchblende. Of course, the Pitchblende may be of any degree of richness from only a few per cent. to over 50 per cent. of Uranium, but between 100 and 200 tons of even the richest Pitchblende would be required to produce an ounce of pure Radium. The commercial compound, usually called Radium bromide, if pure, contains some 58 per cent. of Radium. It is like the myriad of roses we are told go to make a single drop of attar, which is almost priceless.

The Radium that is extracted is a million times more radio-active than the mineral, and several million times more than Uranium itself. Our Fig. 6 shows the autophotograph of a small piece of Pitchblende, which was placed on a photographic plate in the dark, making its own photograph by means of its own rays. We might also state that Radium itself is not luminous, and this is best proven by the fact that weak Radium preparations shine by themselves more in the dark than the pure Radium salts, owing to a phosphorescent action of the impurities which are to be found in the weaker salts.

Practical Applications of Radium.

We now come to the practical applications of Radium. We have shown in our Fig. 2 how the leaves of an electroscope can be made to converge and diverge, and it is upon this principle that Prof. Strutts has designed what he calls a perpetual clock. This is the nearest approach to a practical perpetual device as yet invented. Our Fig. 7 gives a view of this. It consists of a glass bulb, as depicted, which encloses a gold leaf electroscope, some Radium salts and a wire, which latter is connected to the earth. These parts are arranged as shown, and it works as follows:

The emanation of Radium charges the leaves, which diverge slightly until one of them touches the wire at A. As this terminal is connected to the ground, it carries off the electrical charge from the leaves, leaving them uncharged, and they consequently will collapse. The Radium, however, which gives off a continuous charge of electrons, charges the leaves anew, which open, then discharge, and then charge again. A suitable delicate contact could no doubt be arranged to the leaves, so that it would close a secondary electric circuit operating an electro-magnetic device, which would then operate an electric clock. Or a very sensitive attachment could be placed directly inside of the bulb, which would operate some very light hands playing over a clock dial. With suitable means an accurate Radium clock could thus be constructed, no doubt.

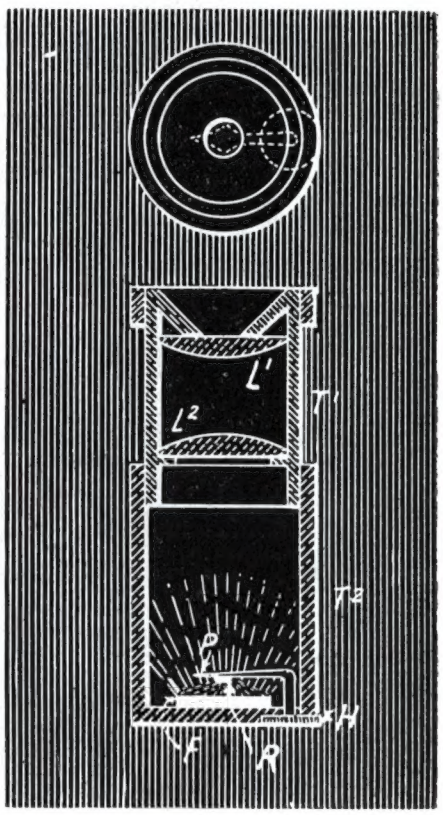


Fig. 9. Details of Spinthariscope Whereby Effects of Radium May be Observed.

We have shown before that Radium is capable of lighting up a fluoroscope screen, and an interesting application is found in producing light through means of this property. In the future it is well possible that buildings and streets may be lighted by means of a similar arrangement as that explained hereafter.

Professor Curie constructed an apparatus as illustrated in Fig. 8. It consists of two large glass bulbs, one having a solution of Radium salts, the other a small quantity of phosphorescent zinc sulphide. The two

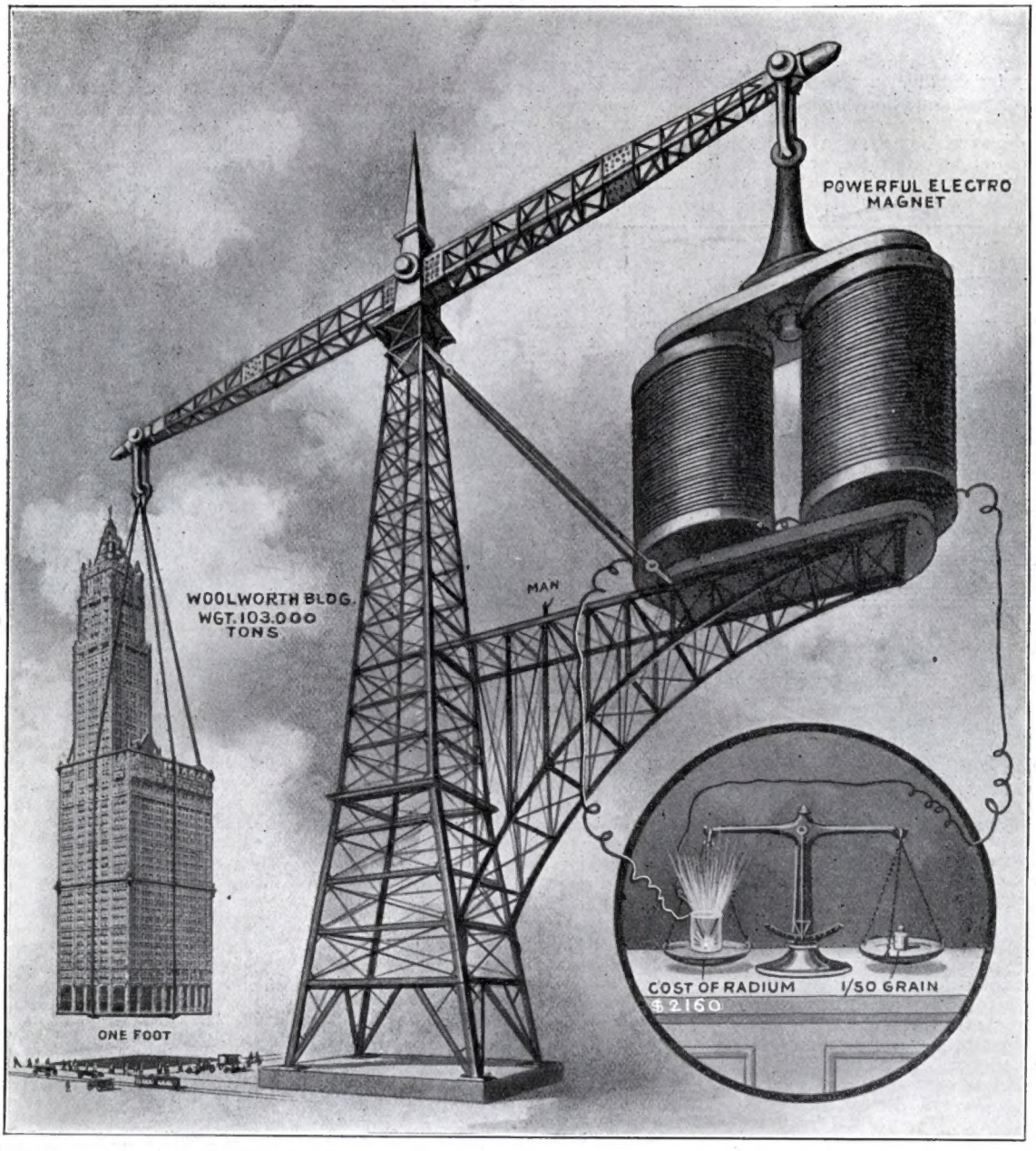


Fig. 14. How (Theoretically Considered) the Energy Contained in 1/50 gram of "Radium" Could Lift the Massive Woolworth Building 1 Foot Above the Ground.

bulbs are connected by means of a glass tube, in the center of which is a stopcock. Upon placing the apparatus in a dark room and opening the stopcock, the Radium emanation will be sent from one bulb through the tube over to the zinc sulphide, and this salt will be immediately illuminated with such an intensity that one is able to read a newspaper six feet away from the bulb, as shown in our illustration. This is so far the nearest approach to cold light as yet invented. As nothing is consumed, such a lamp would, of course, last almost indefinitely.

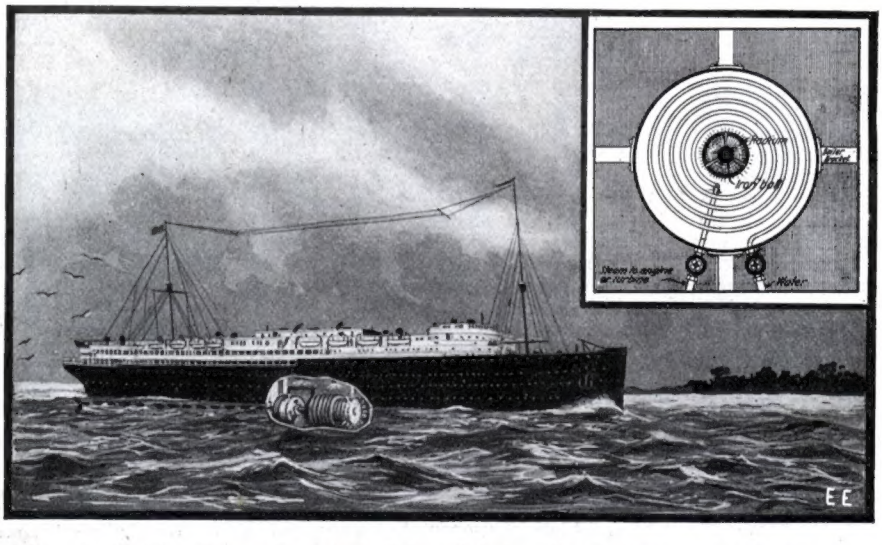


Fig. 12. Modern Ocean Greyhound Being Driven with Radium. Insert, Fig. 13, is Detail of Radium Boiler.

A very clever instrument working on the above principle and termed "Spinthariscope," invented by Sir William Crookes, is illustrated in our Fig. 9. It consists of the following:

There are two brass tubes, T^1 and T^2, the upper sliding into the lower. The upper tube carries two condensing lenses, L^1 and L^2. At the bottom of the lower tube we see a small screen F, covered with phosphorescent zinc sulphide. In front of this is a small pointer P, bearing a small quantity of a Radium salt R. This pointer may be revolved from the outside at H.

(*Cont'd on page* 236.)

Combating the Submarine by Electrical Means

By H. Winfield Secor

THE submarine has already shown its wonderful flexibility in manoeuvering under war conditions and it has kept inventors busy right along, who have endeavored to perfect some means, electrical or otherwise, to detect the presence of such a submerged war vessel even though it be several miles away from its intended prey. A number of different schemes have been proposed and tried out in some instances, but without much success. In the present article some of these schemes will be considered briefly, and they include wireless and other diversified plans and arrangements.

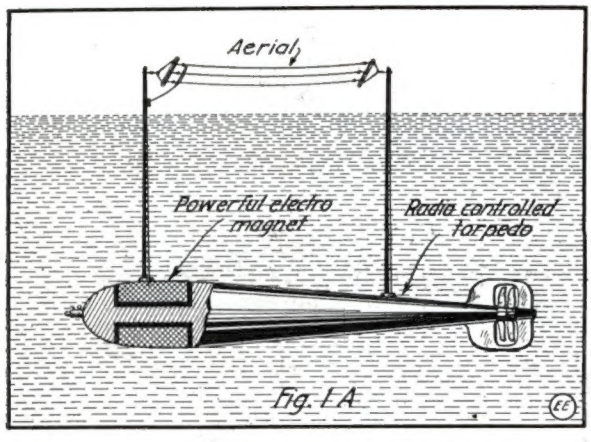


Fig. 1A. Wireless Directed Torpedo Carrying Powerful Magnetic "Head."

One of the latest wireless torpedo schemes has been evolved by a Mr. Gardiner, of Fleetwood, England, and our front cover depicts his scheme in a graphic manner. Simply explained, his arrangement is as follows

An aeroplane, it has been found, can see a submarine when submerged even 150 feet below the surface of the water. It carries a powerful wireless set, and its means of destruction, as regards a submarine cruising under water constitutes a powerful torpedo which propels itself under water and is subject to the wireless control of the man in the aeroplane. The wirelessly controlled torpedo in this case is suspended by proper wires or cables from a non-sinkable float, the latter carrying suitable antennae to pic.. up control waves as sent out from the aeroplane flying overhead.

This idea of Mr. Gardiner's has been very favorably received in England, and it is said that it will shortly be tried out by the English Admiralty. This scheme seems to hold good promise, as is evident in view of the known facts in the case, viz., that it is possible for an aeroplane scout to see a submerged submarine boat many feet under the water, and also that there are successful wirelessly controlled torpedoes existing at this time. Therefore, this invention seems indeed practical, and when the aeroplane scout spots a submarine coming along under the water, he sends out a proper wireless control wave, which causes the non-sinkable float and its attached torpedo to proceed directly toward the submarine. Also it is possible to control by wireless waves suitable mechanisms, such as take-up drums, on the torpedo, so as to cause same to rise or descend. Ballast tanks might be thus controlled for the purpose. The explosion of the torpedo could be, firstly, by concussive contact in the usual manner, or, secondly, it could be exploded by wireless means from the aeroplane; and it would not matter whether the torpedo exploded a couple of feet from the submarine or at a considerable distance from it, as the force of the explosion is transmitted through the water to a considerable distance, owing to the (practically) incompressibility of this liquid

We have all heard, probably more or less, about these torpedoes which can thus be controlled by radio waves of different frequency. In this connection a new suggestion is made as outlined at Figs. 1A and 1B, in the form of a radio controlled torpedo, carrying an aerial as observed, and also having its "head" fitted with a powerful electro-magnet. A scheme is suggested by the writer which, though theoretical in a way, might be applied under certain conditions for the protection of a warship, and also for the purpose of searching out a harbor, etc. This scheme would operate on the principle that, to begin with, we have a powerful wireless controlling station, either on board a dreadnaught, or on the harbor shore. Wirelessly controlled torpedoes of the type shown at Fig. 1A are then employed with the strong electro-magnets attached to them as aforementioned.

Referring to Fig 1B, it is seen how four zones (and of course more zones could be provided for) are covered at different times by wirelessly controlled torpedoes, sent out from properly devised and arranged torpedo discharging tubes. It is to be noted that when the radio torpedo A is at the point shown that its mate, say at B, is opposite it, but traveling in a different direction, and that when B has reached the point X the torpedo A will have reached the point X^1. This holds good also for torpedoes C and D. Thus, by sending out these radio controlled torpedoes, which can be directed and made to go in any direction desired, they are caused to search out the water for several miles in the vicinity of the ship. It is proposed that a ship would carry a net, so as to be able to pick up its returning radio torpedo without danger to itself. Tests made about two years ago in the English navy with torpedo nets proved that torpedoes could be picked up very easily by allowing them to strike the net and then picking them up by means of grappling irons.

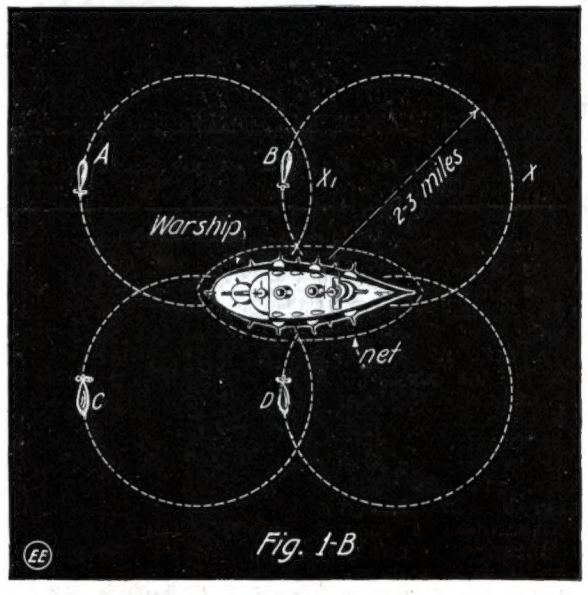


Fig. 1B. Scheme for Protecting "Dreadnaught" from Submarine with Several Radio Directive (Scouting) Torpedoes.

An electrical scheme (it is said) is being used in several navies for the detection of submarines or other vessels when several miles away, which involves the use of an extremely sensitive microphone submerged under water and pivotally mounted on the side of the war vessel or dreadnaught. This device is illustrated at Fig. 2. By suitably arranging the microphone M so as to be constantly and rapidly rotated about its axis, it is seen to cover a complete circle about the ship, as indicated by the dotted line A and B. By properly constructing the microphone M and a horn on same, it seems possible that this method would allow of detecting the sound of the machinery, and especially the *propeller*, of the enemy's war vessel to within a single degree of the compass. Not only does this method seem undoubtedly feasible, but also, with the several types of amplifiers now available, it is a simple matter to hook up one of these with the circuits of the microphones M and to thereby increase the activity and usefulness of this arrangement. As submarine wireless telegraphic communication is carried on by sound vibrations transmitted through the water up to a number of miles, there is no reason why this scheme should not prove efficacious in every way. Of course, suitable telephone receivers or other indicating means are connected to the microphone circuits.

In this direction of scientific apparatus for the detection of the presence of a hostile warship in the neighborhood of a dreadnaught there is often brought up a more or less logical argument by many, viz., that, having obtained the information aforementioned as to the presence of a submarine, say, then what good is this information after it has been obtained? The answer to this argument would be, it seems, that if those on board the dreadnaught are duly apprised of the fact that a submarine lies within active range of them, then they will take all necessary precautions to ward off any attack by such a vessel. It is evident, of course, that this microphone scheme, for instance, of detecting the presence of a hostile vessel would do its duty, even though the submarine is cruising under water with its periscope out of sight; and if this or a similarly efficient arrangement is not utilized, then it is certainly impossible for those on the dreadnaught, under ordinary conditions, to know of the presence of such a boat.

The dream of a great many inventors in the wireless line, including Ulivi, of Italy, has been to utilize some special form of wireless ray or wave which could be directed toward a submarine or war vessel of any type, and that would cause the powder magazines of same to explode, thereby destroying the hostile vessel.

Ulivi's scheme was demonstrated, it is

claimed, before bona fide naval authorities of several foreign governments, but it has since been stated in several instances that the tests were a hoax and, moreover, that he could not produce the effect he claimed to have achieved with the apparatus employed. Several of the best radio authorities and scientists in this country and abroad have since gone on record as stating that it is indeed very doubtful if there ever

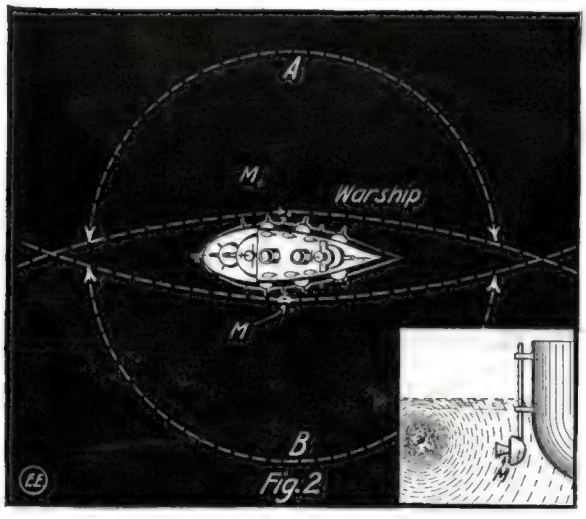


Fig. 2. Super-Sensitive Microphone Picks Up Sound of Submarine's Propeller and Machinery. Note Sound Waves (in Insert) Striking Microphone.

will be such a "wireless ray" perfected which would explode a submarine or the powder magazine in a dreadnaught. This seems, in the writer's opinion, to be the conclusion, reached in any event along this line of research, as in all cases the explosive is encased in metallic shells which are highly impervious to radio waves. Even if such waves do induce (as we know they can) minutely small local currents inside of the metallic shell encasing such explosives, they, as tests have often demonstrated, circulate around the shell and in some rare cases do produce a small spark between two sections of such encased metallic shells where they are not joined together firmly and metallically.

However, and even though this effect is possible, it should be remembered that at a distance of a few miles, even, the energy so produced and localized in a metallic body or shell by wireless waves radiated from a central station is very small. Undoubtedly, from what has been published of Ulivi's work, this effect is what he intended to utilize in his marvelous ray that would blow up all the battleships in the world. If Ulivi had succeeded in his arrangements and apparatus they would undoubtedly have been employed long ago. So there are still good opportunities for some bright genius to bring forth a successful combatant for the modern terror of the seas, "the invisible submarine."

ON CURING ILLS BY ELECTRICITY.

A distinguished European physician, Kowarschik, declares that we are entering on a new era in the field of electrotherapy, as the mechanical technic has been so perfected, while our knowledge of the biologic and therapeutic action of electricity has been deepened in recent years.

The theory of electrons and ions has provided a scientific basis for therapeutic action, a basis more solidly planted, he insists, than we have for the action of most of our drugs. Among the favorable accounts of ion treatment published recently is that of Aufaure with acute and sub-acute articular rheumatism treated by driving a 10 per cent. solution of sodium salicylate directly into the joints with the electric current. The effect was found to be superior to that with internal administration of the drug.

Excellent results in the treatment of chronic nose and ear disease and sinusitis are reported by Friel. A 1 per cent. solution of zinc sulphate, with a current of two or three milliamperes, was used at a 10-minute sitting and repeated at eight of 10-day intervals. Sometimes a single sitting completed the cure.

About half of the cases of sinusitis thus treated were cured and a large proportion of the middle-ear cases. Kowarschik says the eye and ear affections seem to offer a specially favorable field for diathermy, as also malignant growths of all kinds.

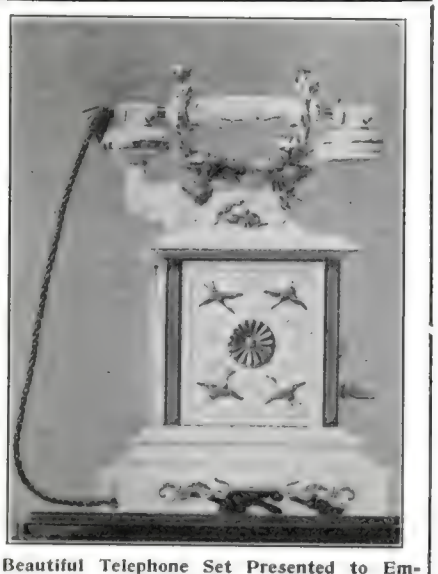
RADIO TIME SIGNALS SENT 4,250 MILES.

The wireless signals sent out by the United States Naval Observatory at Washington have been caught as far away as a point 600 miles north of Rio de Janeiro, which is 4,250 miles from the Government station. Watchmakers, jewelers and colleges throughout the country have installed apparatus for catching the signals. In the past year the daily error in transmission ranged from .055 second to .36 second, due to a change of rate in the standard sidereal clock in consequence of overhauling.

The observatory is seeking an appropriation from Congress for more efficient sending apparatus, declaring that the increased use of the signal for astronomical and other purposes requires a higher degree of precision.

ELABORATE JAPANESE TELEPHONE SET.

The illustration here portrays a very beautiful and odd telephone desk set, decorated with ivory, gold and silver, and which cost about $3,500 to build. This set is illustrated by courtesy of the *Western Electric Co.*



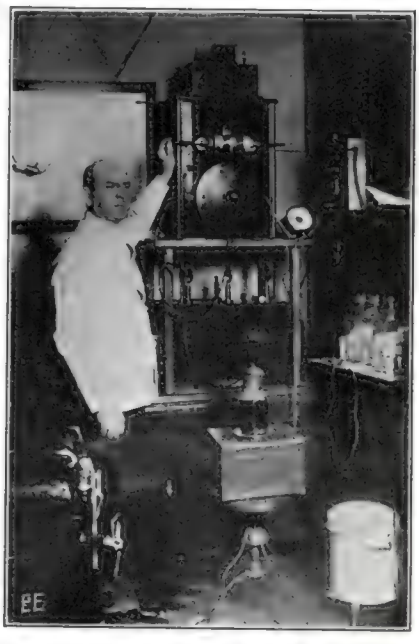
Beautiful Telephone Set Presented to Emperor and Empress of Japan.

This very elaborate telephone instrument was presented to the Emperor and Empress of Japan at the time of their marriage. Some of the Japanese telephones are works of art, but in America we are content to have one standard of finish for our telephones, which makes for maximum efficiency as to talking qualities as well as wearing qualities.

RUBBER PRODUCED ARTIFICIALLY BY ELECTRICITY.

By Frank C. Perkins.

Our illustration shows the electrical equipment by means of which a Cleveland doctor believes rubber can be produced artificially, the chief ingredient of the product being coal tar.



Electrical Apparatus with Which It Is Claimed Substitute for Rubber Has Been Made.

Dr. Lyman A. Noble, an electro-therapist, has declared he has discovered a formula by which a substitute combining all the qualities of natural rubber can be produced. For nearly a year Dr. Noble has been experimenting with ingredients and processes for the production of artificial rubber.

In the process he uses a high frequency electric current. In his first experiments he sought to produce rubber by evaporating the liquid combination of ingredients. This did not produce the [illegible] and in addition to the evaporation process he conceived the idea of submitting the liquid to the high frequency current for an extended time—six hours—and the result was obtained.

It is stated that from 200,000 to 500,000 volts of electricity of high frequency is necessary to produce the rubber. With a current of 1,000,000 volts the time would be greatly cut down, he states.

The various ingredients are mixed, by secret formula, into a liquid which, under heat, is evaporated down to one-quarter of its original mass. When it has reached a consistency of a thick syrup the mass is placed in a metal retort and connected with a high frequency electrical machine used by Dr. Noble, and the retort forms one pole while the other pole is suspended in the liquid. The current is turned off after six hours; the retort contains a black, spongy substance with all the qualities, it is claimed, of natural rubber. A series of tests show that the product resists both wear and punctures to a greater degree than regular rubber.

NEW LOUD TALKING TELEPHONES USED BY THEATERS.

A NEW form of attraction recently installed by a progressive New York City theater is that involving the use of a loud-talking telephone arrangement. This apparatus is illustrated herewith, and it involves several very unique features.

To begin with, this instrument operates on a 110-volt circuit, and the microphone, of the carbon grain type, as shown at Fig. 1, has a diffusing button placed at the base

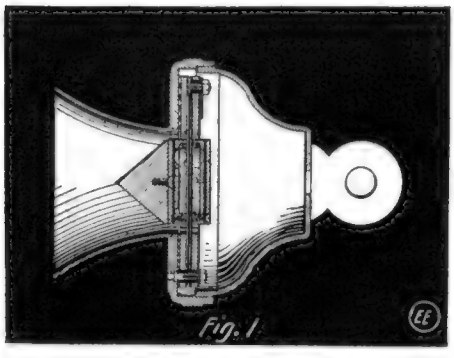


Fig. 1. Special 110 Volt Style Microphone Transmitter for Loud Talking Enunciator.

of the mouthpiece, as perceived. This transmitter is hooked up in series with a couple of 110-volt tungsten lamps of about 50 watts capacity, and it actuates directly the resonator or reproducer, shown at Fig. 2.

The horn on this reproducer is only about

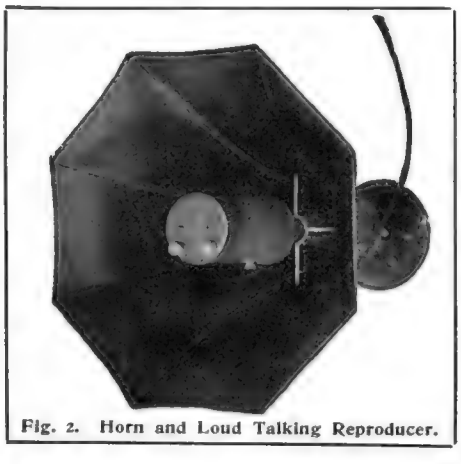


Fig. 2. Horn and Loud Talking Reproducer.

18 inches long, and the appearance of the complete reproducer, with magnet coil, is shown at Fig. 2.

The transmitter is of peculiar construction and especially adapted to stand a heavy current. It employs in its make-up three distinct electrodes, and as it thus has a compartment, containing carbon grains, placed at both sides of the center diaphragm, it is seen that, as compared to the ordinary transmitter, having but one carbon grain chamber, its current carrying capacity is 100 per cent. greater. This microphone has several other distinct constructional features which permit it to be inserted in the 110-volt circuit, and it does not overheat, even when used for half an hour or more at a stretch.

When used to energize from one to five loud talkers or reproducers about ¼ ampere of current is best passed through the microphone.

The special double microphone arrangement, with suitable arm, etc., for use on talking machines where music is to be transmitted through loud talkers, is illustrated at Fig. 3. This specially arranged talking machine is driven by an electric motor, and the switch for operating same may be seen on the side of the cabinet. The two microphones forming the transcribing head in this case are actuated by the regular stylus needle resting on the graphophone record, and suitable wire lead along the microphone arm to and from them.

Considerable interest centers in the improved construction of the loud-talking reproducer, shown at Fig 2. At Fig. 4 the details of the inside mechanism of the reproducer are portrayed. Several years were spent in developing this type of reproducer, which operates on the lever principle. The whole mechanism, shown at Fig. 4, is encased in a tubular metal chamber about 3 inches in diameter by 8 inches long. Large bars of the best grade tungsten steel are used as permanent magnets, and an electro-magnet coil similar to those used in regular telephone receivers or reproducers is mounted on the end of the permanent magnets at A. The iron armature, which is very carefully built, is at one end, directly supported by one pole of the permanent steel magnets, and the other end of the armature is supported and held 2/1000 of an inch from the head of the other pole piece by a mica diaphragm, which is embedded in a rubber cord. A system of levers connects the vibrating end of the armature with the mica diaphragm in such a manner as to cause this diaphragm to have a magnitude of vibration from two to three times as great as the armature. The large volume of sound obtained in this perfected loud-talking reproducer or receiver is due to the powerful magnetic circuit and also to the amplifier vibration effect. The tone quality is due to the mica diaphragm, which has been found much superior to the usual metal form, and also to the manner in which it is mounted in the sound box.

Fig. 3. Special Graphophone and Microphone Arm for Producing Music Through Loud Talkers.

This arrangement is being used for railway station train announcement, restaurant purposes, et cetera, and apparently works better than anything placed on the market heretofore.

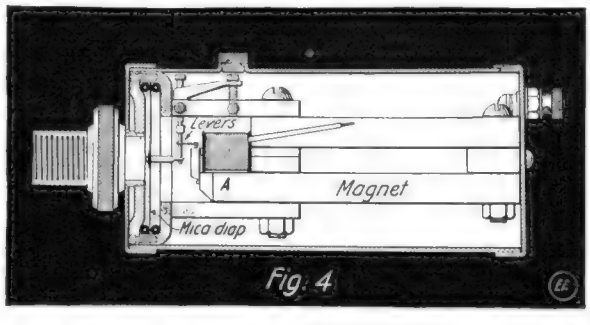


Fig. 4. Reproducer Construction Details.

The reproduced speech from the loud talkers can be heard over distances of 500 to 600 feet, and the articulation is very distinct and perfect; if anything, more so than when holding conversation over the ordinary telephone.

WATERPROOF CEMENT OR CELLULOID.

Celluloid is becoming increasingly popular as a material for making a great many articles. Broken parts are sometimes cemented with a form of glue, made by melting gelatine in sufficient glacial acetic acid to cover it by means of gentle heat, after first standing for 24 hours in the cold. This cement, while strong, is not waterproof. A better cement, and one that will withstand the action of water, can be made by dissolving small cuttings of celluloid in acetone to the consistency of a thick syrup. After applying this solution to the parts that are to be united the work must be placed under pressure and left for some time until the cement is quite hard.

PRODUCTION OF MICA IN 1914.

The value of the mica produced in the United States in 1914 was $328,746, a decrease of $107,314 from 1913, according to a statement of Douglas B. Sterrett, of the United States Geological Survey. The production came from 13 States. The output of sheet mica amounted to 556,933 pounds, valued at $277,330, as compared with 1,700,677 pounds, valued at $353,517, in 1913, and the production of scrap mica in 1914 amounted to 3,730 short tons, valued at $51,416 as compared with 5,322 short tons, valued at $82,543, in 1913.

There was also a decline in imports of unmanufactured and trimmed mica.

A METER, SOME SPIDERS AND A MOTH BALL.

Electric meters in the earlier days of the industry were not always made dust-proof. In fact, it was often possible for wily patrons of some electric light companies to introduce spiders into their meters through cracks in the cases. One spider if introduced promptly after the meter was read would spin enough web, it was learned, to retard the meter disc and to effect a considerable reduction in the electric light bill. According to stories told by operators of those early days, a single moth ball if placed in each meter case could be depended upon to eliminate all trouble from spiders.

Some Late Theories for the Young Scientist

By Rogers D. Rusk, Science Dept., Defiance, O., High School

HERE in the United States we have a vast army of boy scientists and experimenters from whose ranks the masters of theory and the practical inventors of to-morrow will arise. A deal more would be accomplished and a greater number of these budding geniuses would be more surely successful, if they had proper guidance in their early efforts. The writer wishes in the present article to point out a few of the more important theories of the day and the opportunity for their further development.

Men, from time immemorial, have pondered on the great questions of this life, and the ancients who spent their lives in search of rich truths were known as philosophers. Very soon philosophy was divided into two great divisions: one being the study of life, its reason and purpose, and the other being a study of matter and force and all the phenomena of nature. From this the latter was called natural philosophy, or, as we now know it, the science of physics.

Many have been the theories regarding the construction of matter from the subjective theory that matter exists only in the mind, to our latest, the electronic theory. The atomic theory of matter, of which the electronic theory is only a deeper interpretation, has become so well founded and satisfying that scientists now never doubt its general validity, but the farther and farther we study, the more we see that all theories are more or less *glittering generalities*, whose greatest use is to give us room to stand on while we endeavor to grope and feel a little farther.

Matter was first found to be divisible into small particles known as *molecules*. These were the smallest particles of a substance which would still retain their original characteristics, and these molecules it was later found could still be divided into the different elements or particles of which they were composed, and these smallest divisions were called *atoms*. It remained now only to find what the atom was made of to know the actual constitution of matter.

In the last few years experiments have proved that the atom is a kind of miniature universe all in itself, and that there seems to be a central body or nucleus and other particles or *electrons* as they are called, revolving about the nucleus, at a probably very great relative distance from it. Certainly our universe seems as infinitely extensive toward the minute as it is limitless in the opposite direction, and few of us realize how probable it is that each universe is only an infinity of smaller ones.

The electron theory is a big step in scientific advance, for now we see that it is possible for all the different kinds of matter to have the same fundamental constitution of nuclei and electrons except in a different number and arrangement. Just what may cause any particular arrangement, whether from internal or external forces, is a big question, and one which will probably puzzle scientists for a long time to come.

The fundamental unity of matter has been the pet theory of many scientists, but a difficult one indeed to prove. A fact often employed to substantiate this theory is found in astronomy. By means of the "spectroscope," the different elements of the stars and planets may be analyzed and in the very young nebulae, which are solar systems in the making, only a few elements are found; while in nebulae in more advanced stages of development, more and more elements are found, until finally the greatest number is found in the older bodies, such as the planets of our solar system.

This seems to point to the fact that as matter gradually goes through the process of evolution more and more different forms are evolved from some common fundamental base.

The electron theory has, moreover, simplified our concepts of heat, light and electricity. A few years ago there was hardly a scientist who would venture a guess as to the nature of electricity. Now the electron has given us a good foothold in theorizing. The Zeeman effect, cathode rays and other phenomena, have by a reverse process, helped to establish the electron theory and Prof. Millikan of Chicago has actually succeeded in *isolating and measuring the electron itself;* which he found to be about one two-thousandth the size of a hydrogen atom. In static electricity and the study of the various electric tubes, the electron theory is particularly applicable and demonstratable.

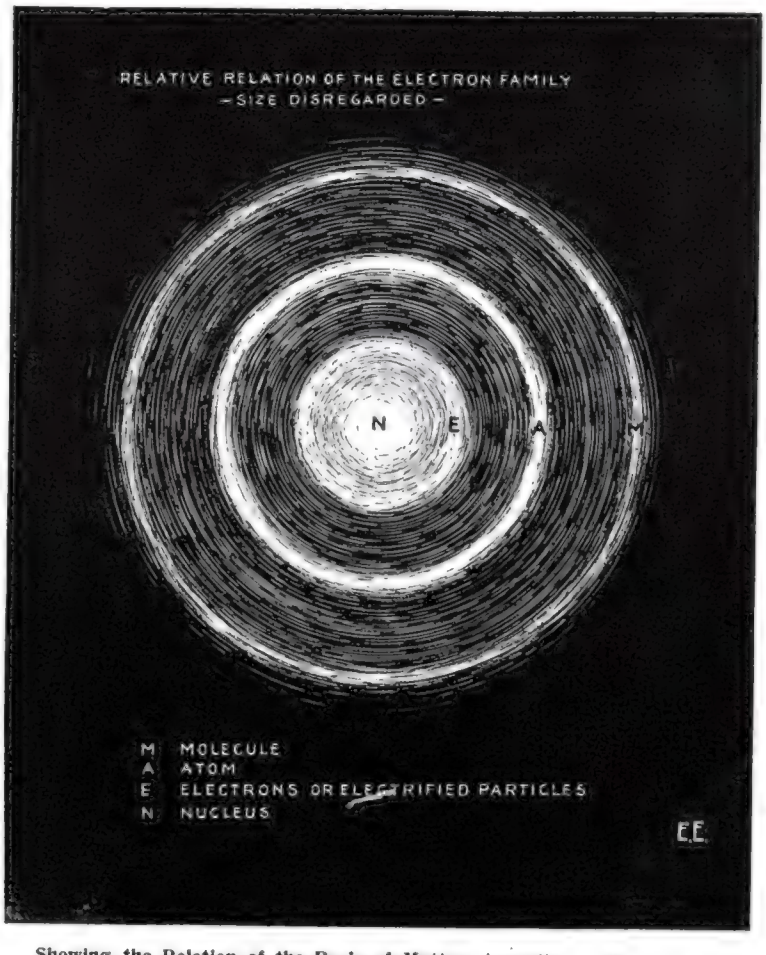
The chemist has been in the dark for a long time on the attraction certain elements manifest for other elements, and this he has named *chemical affinity*. The power of uniting he has termed *valence;* and as in water oxygen unites with two parts of hydrogen whose valence is taken as unity, we say the oxygen has consequently a valence of two. The electron theory opens up with renewed interest the question of valence and what it really is. If it depends on the structure of the atom, and all atoms have the same fundamental constitution, only differing in arrangement and number, then valence ought to vary accordingly. If it does not, and it certainly seems that it does not, then evidently the field here is just opening up.

Physical science may be pretty well summed up in the three categories, matter, ether and energy, and artificial as these divisions no doubt are, they serve the purpose to designate three great fields for research. Of matter enough has already been said and of the various forces which await further investigation might be mentioned, adhesion, cohesion, gravitation and magnetism; the last being not the least interesting, indeed.

Regarding *energy*, we know as little about it as anything else, or as Thomas A. Edison has said: "I calculate we know less than the one-ten millionth part about anything." One of the latest theories is known as the Quantum theory proposed by Planck and adhered to in some form or other by a number of scientists. It is to the effect that *energy*, instead of being a continuous and infinitely divisible quantity as heretofore believed, is discontinuous and resolvable into elemental units or atoms of energy. This is similar to our atomic theory of matter and there is good ground for argument on both sides.

Of the *ether* our knowledge is practically nil, except that it transmits light and light waves according to Maxwell as transverse electro-magnetic vibrations. Here again the electron is dragged in with the electro-magnetic theory. The connection between energy, matter and ether seems indissoluble, and the farther we advance in science the more we see how all natural laws work in harmony, and how it resolves that it is our woeful lack of knowledge that causes us to fail to see the relations and infinite truths of nature.

Recent developments in wireless telegraphy and radiation have opened up new fields of investigation, the results of which only aid us the more in former fields. We are now at a place where we are not hampered by a meaningless jumble of phenomena and (empirical and individual mostly in those days) laws, as the scientists of a few centuries ago were. Our general science of physics is fairly well organized and looking out we can see the vast fields open ahead of us.



Showing the Relation of the Basis of Matter, According to the Latest Scientific Theories.

Omegon

By George Frederic Stratton

NED CAWTHORNE, the young millionaire heir of the founder of the great Cawthorne Electrical Works, glared at the half-page caption in the morning paper:

INTENSE EXCITEMENT IN WASHINGTON

Reports That Seventy Thousand Japs and Chinese Have Been Smuggled Into Mexico During the Last Ninety Days

SECRETARY OF WAR ARMSTEAD IMPERATIVELY SUMMONED FROM FLORIDA

Rumor That Mobilization of U. S. Troops Will Commence At Once

He dropped his elbows on the table and his clenched fists against each side of his strong lower jaw.

"We'll be in it, at last!" There was almost a piteous moan in his low, deep voice. "And I—smashed in that accursed polo game—am on the bench."

He straightened up, crashed his fist on the table and growled: "Ever since this fearful struggle in Europe—always with the chance that our country would be drawn into it—I've been ready. I could raise a troop in a week in Idaho and Wyoming. I'd do it, if I had to mount and equip them myself. And now—now, I'm crippled and useless!"

His man, Frohm, entered the room and announced: "Mr. Kilroth, sir!"

Cawthorne glanced at the big, sturdy mechanic who followed. Then he limped forward with a cordially outstretched hand.

"We know each other by sight, no doubt, Mr. Kilroth; but I've never exchanged any words with you, I think."

"You've seen me in the works, sir. They call me a shop inventor."

"And you have something to submit to me, Kilroth?"

"Yes. The men and the engineers know well how you feel about this war and what you'd like to do; and I've heard of something—a big thing—you can do if you care to put in the money and give orders."

He glanced at Cawthorne, who, with clenched jaws and fiercely flashing eyes, nodded imperatively.

"It's no invention of mine, sir, but I've heard of it and looked into it. It's a submarine invented several years ago. It will run under an armored vessel, and in twenty minutes, or less, all action on that vessel will cease, although no lives need be sacrificed and no damage done to the ship."

Cawthorne's fist crashed down on the table. "If it will do that, Kilroth, why has it not been developed?"

"It doesn't kill," retorted the machinist. "It's been offered to the Government and turned down, flat. It's too small and unimpressive! It's only forty feet long and hasn't got a death-dealing implement on board. Its purpose is persuasion, not annihilation, and the War Department don't take any stock in that kind of stunt."

"Where is it?" demanded Cawthorne.

"There's a model in Providence, and full drawings. The inventor, Wheaton, is a Providence man."

"Can we see it—and when?"

"To-day, if we were there, Mr. Cawthorne."

"We'll be there!" He picked up his house phone, called the hangar, and directed:

"Wansted! Get that gyroplane ready for a trip, at once. Just three or four hundred miles." Then turning to Kilroth:

"You can go, I suppose?"

"Certainly, sir."

The elder Cawthorne's grasp on gigantic industrial exploitations and the financial projects which backed them had notoriously come from his marvelously rapid decisions and determinate action; and Ned was his father's son. The flight over to Providence, the interview with Wheaton and the convincing enthusiasm of the machinist, Kilroth, resulted on that same day in a decision to build some of those submarines. Ned spent a week in placing orders, at several great plants for the shells of the boats and for the various parts of the machinery and equipment. Then he dashed across the continent and secured a large water-front warehouse for the assembling and launching of the boats.

The magic of the Cawthorne name and the two hundred millions back of it, with Ned's evident disregard of cost, resulted in astounding speed in those great shops, and several cars of apparatus were being rushed west by special train when war with the Japo-Chinese alliance was declared.

Kilroth engaged a number of the finest machinists from among his very extensive acquaintance, but not one was informed clearly of the work to be done.

"It's assembling machinery over in San Francisco," he stated. "You'll get triple pay and all expenses; but you'll have to stay and live in the shop till the job's finished. The doors'll be locked when you go in, and they'll stay locked till we're through. Even your mail will be censored! If that doesn't suit you, don't go."

SUPPOSE that some first-class foreign power declares war on us to-morrow. Also suppose that we are outclassed in battleships—we are only the fourth strongest naval power to-day—what would happen? Would American genius prevail? Would our inventors rise to the occasion? Could we annihilate a powerful fleet as suggested in this story? Read this brilliant tale and judge for yourself. It will fire your imagination and it will thrill you, as few stories can.

And, amid all the tremendous excitement of preparation for war, the rush of troops to the Mexican border and the rush of battleships through the canal and along the Pacific Coast, the mystery of the big, sealed-up warehouse in Oakland excited intense speculation from coast to coast. News correspondents made frantic and futile efforts to get admission to the building or into touch with some workman, but the only man who ever responded to the demands at the entrance was Kilroth.

"Nothin' doing!" he'd grin through the small wicket. "You'll have to see Mr. Cawthorne."

That gentleman invariably received them with hearty smiles, cigars and: "Oh, well, boys! Of course you know we're working on some small—very small—submarines; just experimental models, in fact. If they show any promise I shall invite the naval authorities to look at them."

And when the naval authorities were invited to inspect the boats a young lieutenant was sent to the shops. He glanced superciliously at the five miniature boats ranged along the length of the floor and, with a touch of sarcasm in his tones, said:

"A bit small for present warfare, Mr. Cawthorne. The total length of those five boats is considerably less than any one of the new boats they're laying down at the Fore River shipyard."

Ned laughed: "Sometimes machines are like men; the size is no indication of efficiency, lieutenant."

"Possibly so, in industrial matters. But making cotton-cloth or—er—arc lamps is not warfare. It's weight counts there. That last battleship the Japs put into commission is fifteen feet longer than any we've got, and her guns are three millimeters larger caliber. That's what we've got to meet."

Ned shrugged his shoulders. "Examine the principle of this boat. See those great electro-magnets on the deck? When we run under a battleship those magnets will be switched in and hold this little forty-foot submarine as fast against the great hulk as if she was bolted. Each magnet has a pull of 20,000 pounds! Now! Look at these guns pointing straight up from the interior of the boat. Just a little two and a half-inch bore, but they use the new Trotal gelatin explosive. They put as much power behind a bolt as the most modern fourteen-inch gun you've got. Let's go inside!"

They descended through the deck manhole, and in the ample light of electric bulbs the lieutenant saw two bulkheads—the doors open. Aft was the 300-horsepower Hargreaves motor, its aluminum casing and duplex wiring weighing only one-quarter as much as the ordinary motor of the same power.

"Our current is from the marvelous Edison-Seabright storage culminator," explained Ned. "No compressed air to heat up things. The voltage is 2,000, and there's juice enough to run us 600 miles."

The middle compartment contained the controlling mechanism, the gauges, air and pressure valves, and, overhead, the collapsible conning tower. Forward were the breeches of the two Tobin bronze guns, and tapped into each was a flexible tube connecting with chemical tanks overhead.

The lieutenant pursed his lips. "The department has seen drawings of all this before, Mr. Cawthorne. Ingenious, and all that, but giving no indication of practicability."

Cawthorne exploded: "No indication of practicability! How can such a demonstration be made except in actual use?"

"Ah, yes. Of course! But, don't you

see, my dear Cawthorne, that this is no time for experimentation? We have got to fight the real things, and must have the real things to fight with. I should advise you to make a test on some hulk. There's quite a number of played-out tramp steamers laid up here."

Ned's face crimsoned with riotous indignation and a hot retort sprang to his lips, but the lieutenant had stepped to the manhole ladder and started to ascend. He paused on the lower rung and continued:

"Of course, all that is only my opinion, Mr. Cawthorne. I shall make a full report of this, and you will probably hear from my superior officers regarding it."

But as quickly as the hot wave of rage had swept over Ned so quickly it departed, and in its place came a flashing gleam of inspiration. "That hulk!" he muttered, as he skilfully worked his false leg up the ladder steps. "This little lieutenant has put me on the track of success far more than he thinks!

He waved his hand to the departing officer, stumped over to a shed and ran out his roadster. Before that day was out he had signed a check for $120,000 for a laid-up tramp steamer, formerly in the Columbia River lumber trade.

And that evening San Francisco was wild with excitement and alarm over the telegrams:

"Seven Japo-Chinese superdreadnaughts crossing the Pacific, headed for San Francisco. Six others have left Mexico and are steaming north."

Cawthorne dashed down to the big warehouse and got Kilroth into the eight-by-ten den they used for consultation.

"How soon can we run those boats out?" he demanded.

"Three days! There's a conducting wire all ready for charging our culminators and the tanks are connected up, ready for the chemicals."

"Yes!" retorted Cawthorne grimly. "And do you know what we're up against now? That naval expert who was here this morning has nothing but sneers for our boats. They're not large enough to consider. Now, Kilroth, unless we man those boats ourselves, and fight them ourselves, they'll stay right here on the floor. I haven't the faintest hope that the naval authorities will put them in commission!"

"I never had!" grinned Kilroth. "But we can handle them. We'll need three men for each boat—four would be better—and we can get the right fellows from our gang here. They don't know how to present arms and salute a dinky little West Pointer properly, but they'll put those boats just where we built them to be put, mark me, Mr. Cawthorne."

Ned grinned confidently "I'm sure of it!" Then he told of the lieutenant's suggestion to test the submarines on some old hulk.

"I bought the hulk to-day," he laughed. "Not to test the submarines—we'll do that on a Jap dreadnaught—but as a tender. See! She's a pretty fair boat. Now, here's my plan: If the authorities here knew that we were going out to meet the enemy they'd stop us completely; but they're not going to know it until it's done. We'll state that we're going up the coast to test the boats, and we'll start up that way; but after we've run a hundred miles north we'll change into the west and run out into the Pacific and intercept those Japs seventy or eighty miles from San Francisco. Our steamship will cover our approach, will tow us out until she is challenged, and save our power. Then we'll drop our submarines below the surface and go for them."

"That's a scheme, all right," grinned Kilroth. "An innocent looking little scheme that hasn't got any 14-inch guns poking out in front of it."

"Select the men we need," muttered Ned. "Tell them just what we're going into, and that I'll guarantee them a couple of thousand dollars each for the adventure—win or lose. And there may be prize money! If so, it will be big—very big! Now, I've got to select a captain for that hulk—the *Sarah Quimby*."

Four days later the *Sarah Q.* steamed out of San Francisco Bay, and grouped at her stern were the five submarines, decks awash, the tiny conning towers barely visible. They ran up the coast to Gualala, and while the *Sarah Q.* lay at anchor the submarines made below-the-surface cruises, testing out men and equipment.

There were two days of that. Then came, through the Gualala telegraph office, a code message from San Francisco, sent by one of Cawthorne's trusted mechanics, and which Ned interpreted as:

"Wireless from outlying scout cruisers—Jap vessels 200 miles west."

He handed that to Pat Mulray, the new captain of the tramp steamer, and that blue-eyed, red-haired mariner gleamed with joyful anticipation.

"If we start at once, Mr. Cawthorne, we'll cut 'em off a hundred miles out of 'Frisco Bay. That'll be about right, won't it?"

"It sure will, Captain. Admiral Sangster's squadron won't run out as far as that to meet them. He's got to keep near the coast to watch those other Jap ships which are working up from Mexico. Now, you've got it all clear. Run across the line of the enemy's ships. They'll challenge you as soon as you get within five miles—perhaps before. Then you'll lower your flag and stop. They'll send a prize crew aboard, I suppose, and make you and your crew prisoners; but about that time we'll be busy."

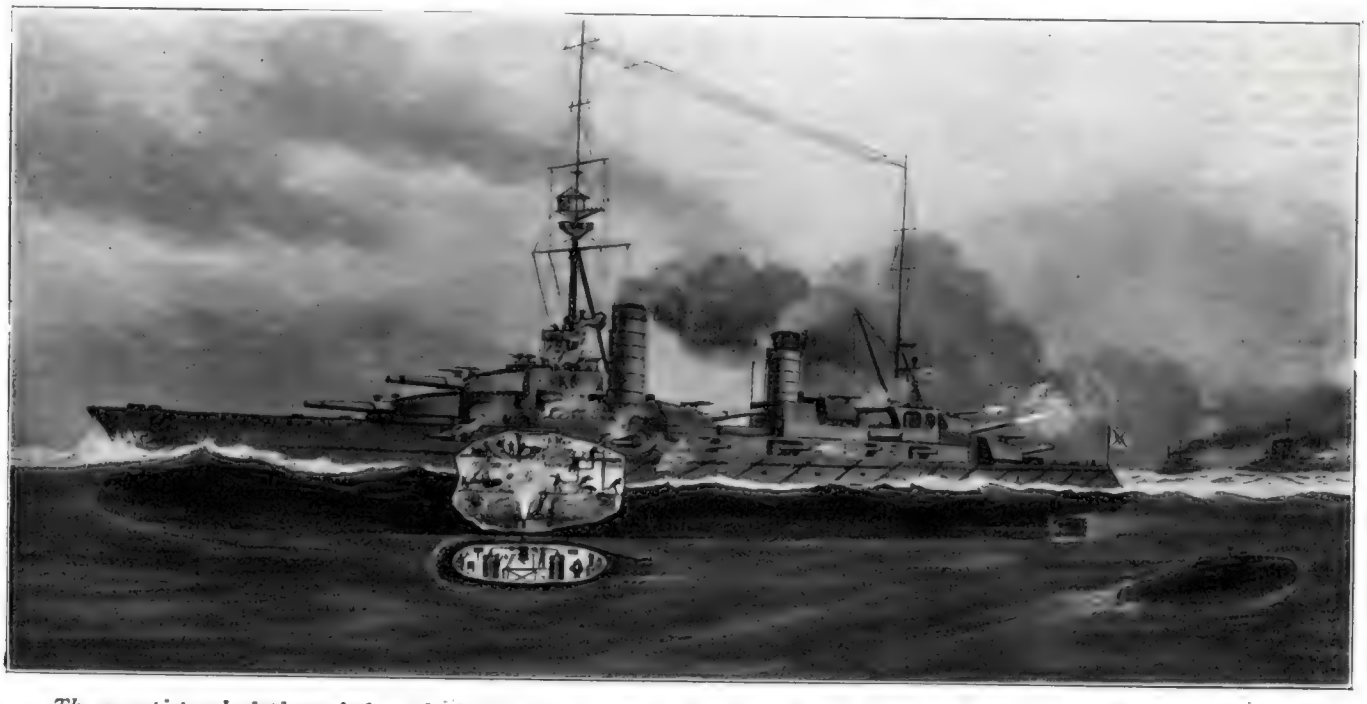
"Glory be! I'd like to be goin' wid yez, Mr. Cawthorne. It's against the grain to be lowerin' the flag to those little brown divils."

"It's the strategy of war, Captain. You'll have the laugh on them a little later."

They steamed out, due west, the conning towers of the submarines just above water, but hidden along the side of the *Sarah Q.* At noon two cruisers, which had been watching outside, were working back toward the coast. They sent an imperative wireless message:

"Turn back! The enemy's battleships are coming in." To which Captain Mulray returned:

"Thanks. Going due south. Will be across before they get here." And for 20 minutes he changed his course so as to avoid any interference from those cruisers.



The gun piston had plunged through the bottom plating of the ship, carrying with it the Omegon ether injection tube.

Then he swung her head again into the west and ran at full speed.

When within 10 miles of the coming vessels Cawthorne gave the order:

"Drop below!" and in a few moments the conning towers had disappeared. At 16 feet below the surface the boats kept together, running at full speed. Ned's boat, No. 3, was in communication with each of the others by means of the new hydrophones which were perfected to an underwater radius of 5,000 yards, and his aerial televisor, floating like a little toy balloon 20 feet above the surface of the water, was showing on the marvelous electric screen below the positions of the battleships.

"They're running half speed!" he exclaimed, exultantly. "Look at the funnels! No forced draft there! I'll bet they are holding back so that their southern squadron'll reach San Francisco when they do. That'll give them 13 ships against Sangster's 11."

When within two miles of the ships the televisors were hauled down. Ned gave his last orders to the other boats, and each started independently on its mission. They darted through the smooth subsurface at full speed, and in less than five minutes the magneto-detector in Cawthorne's boat showed the nearness of a mass of steel, its needle pointing accurately to that mass. Ned steered to one side of his prey, swung sharply around and darted under the monster—the flagship of the Japo-Chinese alliance and the most furious hell of destruction ever constructed by man.

"Half speed!" he yelled, and Bundy slipped the controlling lever over. Wheatly, the third man, stood by the submerging wheel.

"Up—easy!" commanded Cawthorne. Then he sprang to the forward magnet while Bundy jumped for the other, and there was a dull thud and scraping sound as the magnets of the submarine came up into contact with the bottom of the *Matzuma.*

"Hold her!" he shouted, and threw his switch, and the distinct jar and click showed that the connection was made.

Cawthorne peered from the bullseye in the tiny lookout, just large enough to take his head, and he threw on the concentrated electro-magnese ray. "Pretty well forward," he muttered. "Jump for that forward gun, Bundy! Fire it!" and the next moment there was a crash which jarred every rivet in the boat. *The gun piston had plunged through the bottom plating of the ship, carrying with it the injection tube.*

"Stand by that pressure valve! Let her go!"

Wheatly swung the valve, opening connection to the chemical tank above and forcing the *Omegon* ether, under 300 pounds pressure, through the gun piston tube into the bowels of the great superdreadnaught. Cawthorne stepped to the pressure gauge and watched it for eight minutes, which seemed like eight days to the other men. Then, his face grinning through a flood of sweat, he exclaimed:

"We'll give them the other tank in the other end now. Stand by those magnet switches! Throw 'em out!"

The great magnets went out of commission and Cawthorne threw in the propeller switch, casting off so as to permit the submarine to slip along the bottom of the battleship toward the stern. Suddenly he yelled, "Hold her!" and again the magnets took their bull-dog grip on the steel plating.

Again and again came the fearful crash of the great guns above them. "They're firing on the cruisers, I guess," grunted Ned. "Let 'em have that other gun, Bundy!" and he sprang to the pressure valve. The operation on the forward end of the ship was repeated aft, and as Cawthorne's eyes were fastened on the gauge, Wheatly exclaimed:

"It's getting in its work, Cawthorne! The for'rd guns are silent!"

"Well, we've done all we can," grinned Ned. "Let's get out of this!"

Again the magnets were switched off, the propeller motors put into action, and the nose of the submarine pointed down as they darted away from the bottom of the huge dreadnaught.

They ran for two miles before raising the televisor. Then it was allowed to float up to the limit of its 40-foot cable. Cawthorne's eyes were fixed on the wonderful screen which revealed all that the televisic eye above saw. Wheatly stood by him, every nerve tingling with excitement.

"The *Matzuma's* engines are stopped!" he half yelled. "See those funnels!"

"There's the *Sarah Q.!*" grinned Cawthorne, as the televisor was slowly revolved. "Flying the Japo-Chinese flag, too! They took possession of her pretty quick. I wonder what Captain Mulray's doing?"

MÜNCHHAUSEN?

YES, how about him, what happened to the old boy? Was he really struck by a meteor and was he killed? No, dear readers, nothing of the sort happened. Meteors may be fast, but not fast enough to catch our beloved Baron, no sir.

To explain: When the usual installment did not arrive from our far famed correspondent, I. M. Alier, of Yankton, we sent him several urgent wireless messages. Here is his answer:

Editor E.E., New York:

Sorry no installment this month. Münchhausen and Prof. Flitternix left for Planet Mars in their "Interstellar" some time ago. Will return to Moon, Sept. 10th. Expect sensational story. Hold presses till last moment to catch October issue.

I. M. ALIER.

The above explains it. If everything goes well, we ought to print a wonderful story in the October issue. We're kind of excited to know what's doin' on Mars, aren't you? Better order your October issue now.

"Our battleships are coming up!" he added after a short pause. "If our submarines didn't get in their work there'll be a fight, right out here. But four of the enemy's vessels are not steaming, and our cruisers are falling back to meet Sangster's ships. I guess we'll fall back too, Wheatly. We ought to report what we've done so that the Admiral can follow it up."

They headed back east at full speed, and in a few minutes were near the *Texas,* which was turning her propellers just sufficient to give her steerage way. Flying the Stars and Stripes from the aerial mast, Cawthorne put his short wireless into action.

"*Texas:* Can I come alongside and report? Our submarines have been in action and have silenced four of the enemy's ships, I think."

There was a few minutes' delay. Then came the answer: "Come alongside."

Five minutes later Ned climbed onto the deck of the cruiser and faced the lieutenant who had inspected his boats.

"We have discharged our Omegon ether into the *Matzuma,*" he exclaimed, "and I believe, from the appearance of the enemy's ships, that three of the other submarines have done the same!"

"Good Lord!" ejaculated the officer, "is that what it means? Come aft, Mr. Cawthorne, and report to the Commander."

He was taken to the bridge and again stated what he had done. Commander Preston made no comment, except: "Four of their boats are out of action—are not even steaming. Mr. Pearsall! Direct the wireless officer to report this information to the Admiral. Mr. Cawthorne, go onto the main deck, or below, if you wish. One of their vessels is getting our range."

He went to the deck, and as he reached there a fearful, ear-splitting crash broke out astern. Staggering around, he saw the gigantic *Arizona* about a mile away. Then a hand was clapped on his shoulder and a deep voice said:

"Mr. Cawthorne, I believe?"

It was the ship's surgeon. Without waiting for a reply, he went on: "Something extraordinary has happened, or is happening. Three or four of the enemy's ships are out of action, and our Commander has just been signaled to send a prize crew aboard the *Matzuma.*"

"The *Matzuma!* The vessel we put to sleep?"

"Evidently. Her flag is down." Then, after a long glance through his binoculars, he added: "I make out two other ships—flags down!"

"Then my submarines did get in some work," muttered Ned. "I'd give a million to hear from them—to learn if they are safe. Surgeon, is there a bare possibility of calling Gualala? I ordered those boats to run back there when they got through."

The officer shrugged his shoulders. "I think we all feel curious about that. Stay here, Mr. Cawthorne. I'll see the Commander."

In a few minutes he was back. "The Commander has ordered communication with Gualala. He's as eager as you to know how your men and boats have come through. It's marvelous, simply marvelous! Five of those tremendous new superdreadnaughts have surrendered without landing a shot! Most of the firing came from the two which our ships are now chasing! Here comes our launch—the one that took the prize crew out to the *Matzuma.*"

And as the officer in command of the launch came on board he was followed by Pat Mulray, captain of the *Sarah Q.* Utterly indifferent to the uniformed men about him and the officers on the bridge, he made for Cawthorne in an Irish hornpipe step which was a revelation of irrepressible overwhelming joy.

"Glory be! Man, dear, yez did it! Hould on, now! Hould on! I'll tell yez all about it if ye'll let me lay me own course. Whin the *Matzuma* sint a launch over to take possession of the *Sarah Q.* they had orders to take me back to the flagship. So I wint. Whin I got there they began askin' me about th' little *Sarah,* an' what I was doin' wid her out there. But divil a wor-rd about th' submarines. They knew nothin' of thim, at that toime; but they got th' knowledge of thim without askin' me. Before they asked me more than twinty questions an' got th' neat little lies I had ready for 'em, the for'rd guns stopped firin' an' th' officers an' deck crew were tearin' 'round, crazy as hornets. They opened some hatches an' jumped in, an' came out again carryin' out men as limp as dead eels, an' laid 'em 'round th' turret base like bars in a capstan.

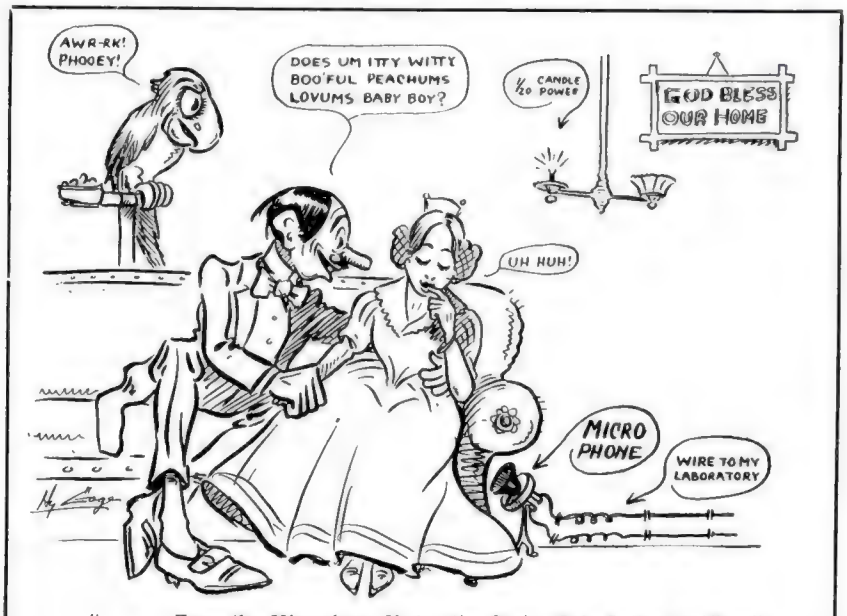
(*Continued on page* 237.)

The Old "Bug" Speaks

By Thomas Reed

IN many hearts the warmest spot is reserved for the boy experimenter, the "scientific bug." In mine that spot is so large that it threatens to include the entire organ. Do I know anything about bugdom? Listen.

The youthful bug is always poor. His scanty finances have to be spread as thin as a coat of paint over the vast area of his desires. How we envied the lot of the fortunate exception, the boy whose parents "encouraged" his taste, giving him unstined "dough" wherewith he acquired "boughten" instruments, driving us to what in later years would be drink. Long, long afterwards we knew that the favored child of fortune was missing all the fun of the thing. Once the oh's and ah's of the have-nots had died away he had nothing to do but turn his nickeled handles and grow tired of his toy; while we progressed from one triumph to another, conquering not only the forces of nature, but the attacks of "outrageous fortune." The first was easier than the second.



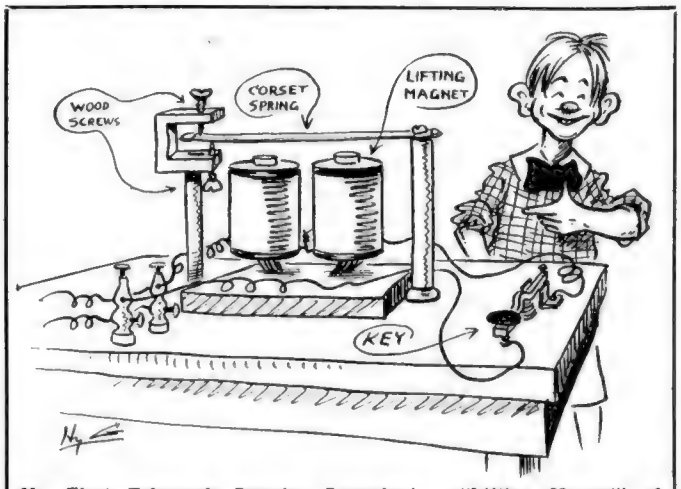
". . . . Even the Microphone Under the Parlor Sofa Palled in Time."

Bits of material and parts from other mechanisms were our hoarded wealth. Clock movements and curtain rollers were mines of opportunity. Broken electric light carbons and sheets of lead-foil from the tea-chest were what the solemn ones call "mediums of exchange." Feminine finery helped the cause—what should we have done without the trusty corset steel? It was supplemented in my day by the flat wires of the last of the hoop-skirts, ravished from its dusty retirement in the attic.

With us it was not to copy, but to extract the principle and adapt to it such material as we had. My first sounder was a big lifting magnet, with an armature of that corset steel of grateful memory, all imbedded in a wooden block with an adjustment contrived of wood screws. It resembled no sounder since the days of Morse, but it worked.

It was in the days of my early *bughood* that the telephone swam into the ken of a waiting world, surrounded by an awesome halo of patent suits. We used to tremble at the step of the policeman on the beat, apprehensive of what the American Bell Telephone Company would do to us if they should catch us with the goods—our poor little wooden receivers made in defiance of the great seal on those patents; but somehow we escaped the felon's cell.

It was the telephone that first broadened the horizon of us bugs. Before that there was only the telegraph, electric bells to ring for purposes supposed to be useful, electric clocks and such like. Oh, yes, an electric wind-vane; to be sure, there was already a vane on a barn in full view of my window, but I persuaded myself mine was more accurate. The telephone began to realize the ideal which has attained its full glory in the wireless. It was a really delicate instrument, yet so easy to make as almost to defy the possibility of failure. Bugdom was elated when its first pair of receivers transmitted words, not only perfectly, but with the individual characteristics of the voice; but given a magnet, a little coil of wire and a diaphragm, and it would tax the stupidity of the head bungler from Bungleville to make one that would not work.



My First Telegraph Sounder Comprised a "Lifting Magnet" of Heroic Size, Together With a Corset Spring and Some Wood Screws.

Of course, I am a wireless bug to-day; but I sometimes wonder, looking back to the lean old times, if the present buglets realize what a seventh heaven they were born into by wisely postponing their birth date till now. Our old machines seemed somehow to lack a vital use. The electric bell that repeated in our room the blows of the kitchen clock was entertaining, but superfluous. The telephone and telegraph once perfected we found it a bore to think of something to say. The wind vane, rain gauge, etc., recorded only slow processes of nature; it was a long wait between changes. The electric clock was good, but monotonous. Even the microphone under the parlor sofa palled in time; variety again was lacking. We yearned for something that, once in operation, would bring us returns from the outer world—continuous, changing, worth while—and there was nothing till the wireless came.

But now what a paradise for the patient bug! Instruments, the coil, the detector, the condenser, within the power of anyone to make. And once made, like the glittering paraphernalia of the wizard, they open a wide door into a new world. You push your sliders, turn your switches, feel for that elusive sensitive spot on your galena, and presto! "the world is all before you where to choose." You hear the fussing of the amateurs from near and far with "O. M.," "C. U. L." and "How is my wave now?" The crisp, abbreviated messages between ships and from ship to shore—here comes the Campania, the Lusitania (alas, no more) just on time, and what a babble is exchanging of "Greeting" and "Love" and "Meet you at the dock."

Here is the weather forecast for to-morrow, hot off the griddle at the navy yard; almost equally important, the baseball scores after the playing is finished for the day. The correct time, straight from old Father Time himself at Washington. The weather conditions in their simple code from a dozen stations; the "winds for Tuesday and Wednesday—North Atl., Middle Atl.," and all around to the Great Lakes Some times the brief, grim tale of an "obstruction to navigation"—an iceberg, a waterlogged schooner in such and such a latitude and longitude. Careful Grandma Wellfleet with her "latest news of the day" —what a boon at the summer camp, where the morning paper will not come in till afternoon, if it comes at all! And so on till the German station starts its all-night toil, rapid, nervous, now in German words, now in English, pouring urgent messages over an iron-bound frontier and a zone of desolation and death.

ELECTRICAL EXPORTS TO ARGENTINE REPUBLIC.

May exports of Argentina from the port of New York included $63,000 worth of electrical supplies. To Brazil, there was sent in May from New York, $34,000 worth of electrical material and supplies.

WHAT IS A WATT?

By P. W. Pelts.

The writer has been asked so often, "How many volts is in an ampere?" and, "What is a kilowatt?" that he has thought of mimeographing the answers and carrying them around in his pocket. However, since the *Electrical Experimenter* is read by practically everyone interested in the subject, a contribution to this excellent magazine would be more far reaching than the typewritten copies would be.

Although we can neither see nor hear the electric current, still it is just as easily handled and utilized as a water fall. Both are sources of energy; both can do work. You can buy and sell the one, just as easily as you can the other. Either can be parcelled off in small packages or sold in job lots. The electric energy can be packed away in small jars and set up on the shelf to "keep," or it may be shot off along a pair of slender metallic threads, to run the shops and street cars of a city three hundred miles away and also light its streets and homes.

Water is sold by the cubic foot or by the gallon. One way or the other, it is a definite quantity, at a definite price. Electricity is sold by the AMPERE*, just as we sell water by the gallon; an AMPERE of current therefore is just "so much." One horse drinks half a gallon of water; twelve horses drink six gallons. One lamp takes half an ampere of current; and twelve lamps require six amperes. A little pony could drink but a small fraction of the gallon, so also a small lamp can take in only a small part of an ampere. A twenty-five watt Mazda lamp uses about one-fourth of an ampere and the 100-watt lamp uses almost a full ampere. An arc-lamp requires from six to ten amperes.

It is well known that some substances will carry the electric current better than others. Silver is one of the very best conductors, with copper a close second. Iron is rather poor, lead is worse, while German silver and Mercury bring up the rear as conductors. Substances that are poor conductors push back against the oncoming current. This ability of a conductor to retard the flow of a current through it, is called resistance, and it is measured in ohms.

A water pipe of small diameter will deliver much less water in a given time than one of larger diameter, although both be connected to the same tank or reservoir. This is because of the resistance offered by the sides of the pipe to the flow of the water. An exactly similar condition exists in an electric circuit. A wire one-fourth of an inch in diameter will offer much less resistance to the flow of an electric current than a wire only one-eighth of an inch in diameter, consequently more amperes of current will flow through the larger wire than through the smaller.

As was said before, the resistance which a substance offers to the flow of electricity is measured in OHMS. The standard OHM is that resistance offered by a column of mercury 106.3 centimeters in length, and one square millimeter in cross-section at 0 degrees C. This is equivalent to a length of mercury 41 4/5 inches and 155/100,000 square inches in area. 9.35 feet of No. 30 copper wire and 6.2 inches of No. 30 German silver wire have the same resistance. 93.5 feet of No. 30 copper wire would have a resistance of 10 OHMS, which would be just the same as 62 inches of German silver wire of the same thickness.

From the above it will be seen that the resistance of a conductor increases with its length and decreases with its diameter, also, that different substances offer different amounts of resistance.

Now since all conductors possess this quality of resistance, and this means that they are able to push back against the oncoming current, we must use force or pressure to push our amperes of current through the conductors so that they may be of use where they are wanted. Take the case of a 55-watt Mazda lamp. The little hair-like filament of this lamp is very small indeed and possesses 220 units of resistance or OHMS. To heat up this filament to full brilliancy we must send through it half an ampere of current. In order to get our half ampere through the lamp we must exert a push or force greater than the backward push (or electrical inertia) exerted by the lamp filament. This force which pushes our half ampere through the lamp, can be measured just the same as the force or pressure of a steam boiler. The unit of this electrical force is the VOLT and it is equal to about two-thirds of the force which can be exerted by an ordinary dry-cell. In other words a single dry cell can furnish a pressure or force of about one and a half VOLTS. It has been found by experiment that the pressure required to force half an ampere through the above mentioned Mazda lamp, is about 110 VOLTS.

Ohm's Law is a formula which enables us to tell what pressure is required in any case, when we know the current and resistance. It is written as follows: VOLTS equals AMPERES times OHMS. ½ AMPERE times 220 OHMS equals 110 VOLTS. If we know the electrical pressure furnished by the power company, and the resistance of a circuit, we can tell before hand how much current will flow. To do this we can transpose the factors in the above formula, so that it will read: AMPERES equal VOLTS divided by OHMS. Thus it is that 110 VOLTS divided by 220 OHMS gives us ½ AMPERE.

Since the power company has to furnish us with the amperes of current to light our lamps, and also the pressure to force the amperes through the lamps, they are going to charge us for both the VOLTS and the AMPERES. Edison's first electricity meters measured only the AMPERES that ran into the customer's lamps, then the bookkeepers in the office had to figure out the rest of the bill. The modern meter, however, measures both AMPERES and VOLTS. In fact it multiplies one by the other and gives the answer in WATTS. A WATT, then, is a VOLT times an AMPERE, and is the unit of power. Half an ampere of current flowing into the lamp for one hour, forced through the lamp by a pressure of 110 volts, gives us 55 watt-hours. If the electric company charges at the rate of 1/100 cent per watt-hour (which is the same as 10 cents per kilowatt-hour) our bill for burning the Mazda lamp for one hour is approximately ½ cent. Thus the consumer of electrical energy will have some idea of how his watt-hour meter "adds up his bill."

[*Not strictly speaking; the watt is the unit of electrical energy. See the author's later paragraphs.—Editor.]

THE WRAITH OF THE WIRELESS

By Rose Seelye-Miller.

I was a voice enthralled,
And at command I called
Over the sea, where the white ships ply
Over gray icebergs, through foggy sky;
Sharply or softly, the vibrant air
Carried my message, shriek, or prayer.

Chanted the watchman, "All is well."
A crash! Pandemonium! Hurry! Hell!
My master's hand clutched at my vibrant throat;
Choking, I hurtled a single note—
In a mad, metallic S. O. S.
I shrieked out my signal of distress.
S. O. S.! S. O. S.! S. O. S.!
I shrilled and I prayed in wildest stress,
Save our souls! Save our souls! Save, Oh, Save!
From the iceberg ghouls and the deep sea grave!

Save! But the hand that hurled me wide
Fell from duty to death in an awful tide.
My Master's power was too weak to save
A mighty horde from a mightier wave.
Had I been mortal, my throat with Death
Would have choked and rattled with frigid breath.

But I live, and Master, Master, I fly
Over fields of ice, through foggy sky,
Futile, finite, hushed and stilled,
Without thy hand that touched and thrilled.
I'm a wandering wraith, without control,
For my voice went out with my Master's Soul.

Some time, somewhere, in infinite light,
I shall answer again to my Master's might.
Neither futile, nor finite, then will be
His hand with its perfect mastery.

EDITOR'S CHAT

We sincerely hope that you will like this issue. Containing as it does 144 illustrations and 128 different articles, it is without a doubt the largest and most complete popular electrical magazine ever printed in this country. No expense was spared to produce this big issue which is the equivalent of an 128-page standard-size magazine. But while it may satisfy you, we are not as yet at the end of our efforts. We will try hard to surpass this number; indeed the coming October issue will even be better.

There will be several big feature articles, several new "cracker jack" stories, including "Münchhausen" on the Planet Mars. There will be a wonderful article for the Constructor and a bunch of new wireless articles to gladden your heart.

But before we forget it: This issue is so big only due to our advertisers. You must thank them rather than us. You cannot show your appreciation better than by writing for their literature and by patronizing them to the fullest extent. Only—and only so—can we enlarge the magazine still further. It's up to YOU.

And before we forget, order your October issue early, NOW.

Massachusetts students of wireless have had good success with experiments in sending and receiving messages with aerials laid on the ground.

Luna Park, New York's "Joyland"

WHEN the proverbially tired business man of the great metropolis of New York looks about for a place in which to clear away his worries, he invariably jaunts forth to that "Mecca" of all pleasure seekers in the "Eastern" United States, Luna Park. Some of the beautiful effects attained in the arrangement of the electric lighting of this playground of playgrounds may be partially gleaned from the accompanying views.

This wonderful pleasure seekers' paradise is, like a great many other institutions of its kind, to be seen only at its best when cast under the mantle of night. Then it is that Luna Park looms up as a scintillating fairy-land, outlined and dotted everywhere with thousands upon thousands of electric lights, of every color and size imaginable.

The top view of the group here reproduced, shows the wonderful gate way to this amusement park. The three circular dials over the central gate constantly revolve and show three different colors of electric lights, red, white and blue. The photo at the left is a closer view of the main arch-way or entrance to this fairyland and the Midway may be seen very well in this picture.

This is only a portion, of course, of the many wonderful and magnificent attractions of this park. The view at the right of the group shows the Midway more in detail and here can be seen the many beautiful illuminated towers and minarets of Luna Park at night.

The lower central photo shows The Tower of Jewels, which is garbed in a handsome manner with thousands of electric bulbs and as this is situated alongside one of the lakes or lagoons of the pleasure ground, the reflection and general scenic effect at night is very entrancing and decidedly oriental. In fact, this seems to be the underlying theme in the general arrangement and architectural layout of Luna Park. This oriental effect, to be sure, gives a bewitching charm and quaintness not easily duplicated otherwise.

There are a great many interesting attractions to be found here, which depend mostly for their operation upon electricity. The largest scenic railways and the like ever built are to be found here. Many mysterious and novel attractions are provided for the public's amusement besides numerous wonderful scenic attractions operated electrically and covering such subjects as "The Dawn of Creation," "A Trip to the Moon," et cetera, which may be enjoyably viewed at a very nominal sum.

It is the next best thing to 'Frisco's great exposition and for those who cannot make the trip across the Continent to see the wonders of the Western exhibition, Luna Park is worth a visit by everyone. Besides it is located on the ocean's shore, where cooling breezes always abound to make one's visit both refreshing and enjoyable.

Views of the Beautiful Night Illumination at Luna Park, New York.

NEW POCKET WIRELESS TO AID OFFICERS IN WAR.

Guglielmo Marconi, noted Italian inventor, left for London on a secret mission recently. It was reported that Marconi has perfected a new pocket wireless system for the use of Italian forces in the field, by which officers at the front can keep in touch with headquarters all the time.

UNCLE SAM WILL HAVE ELECTRIC BATTLESHIP.

The first electric battleship will be added to the United States navy in two years. It is the California, which is to be built at the Brooklyn Navy Yard at a cost of $7,000,000. It will also be the largest battleship yet built for our navy—624 feet long and 97 feet wide, with a displacement of 32,000 tons and a speed of 21 knots.

Its main battery will be 12-inch guns. It will have a torpedo defense battery, which the European war has shown to be of great importance. This battery will have 22 5-inch guns.

Inventors have long dreamed of an electric battleship. With the California this will be realized and with it we lead the world, just as we led it by the device of "central fire"—that is, having the heavy guns over the keel instead of at the sides—a device that the new European battleships have copied.

In the California there will be no directly connected turbines. The power will be transmitted to the four screw propellers through slow-speed motors which will relieve much of the strain on the crank shaft. The electric power installation will consist of two separate plants, each furnishing power for two screws. If desirable the ship can be operated on one generator. Electricity provides the smoothest and most flexible method known of propelling, steering and operating a ship.

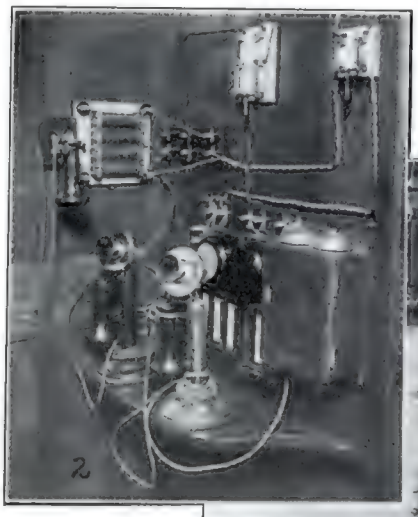
WEATHER BY INTER-CITY WIRELESS.

Advices received recently from Cincinnati stated that weather bureaus of that city and Pittsburgh would soon exchange information by wireless. The announcement was reported to have been made by Weather Forecaster W. C. Devereau, of Cincinnati, that preliminary arrangements for the installation of the service were made at a conference between Mr. Devereau and Henry M. Rubel, Jr., who is installing a station at Cincinnati. Mr. Rubel is said to be connected with the Marconi company, and proposes to erect powerful plants at Pittsburgh, Louisville, Evansville, Huntington, Cairo and other cities, and to co-operate with the weather bureau in each city in disseminating weather and river information. The stations are expected to be ready for operation by fall.

To analyze the unburned gases given off by industrial plants a French scientist has invented electrical apparatus which makes the tests and records the results automatically.

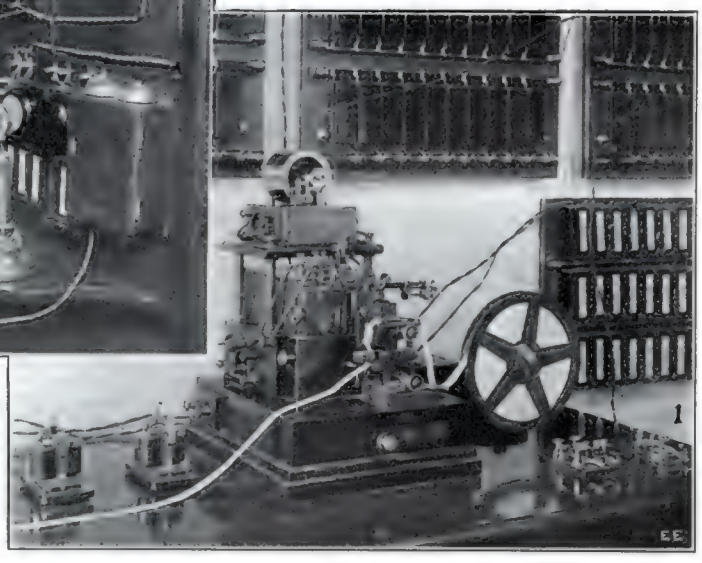
Long Distance Submarine Telegraphy and Telephony

HOW would you like to speak to your friend in Cairo, Paris or Liverpool from your office or home by simply removing the receiver, get central to connect you and then hear your friend's "Hello" over the wire? This may soon be a realization, as the inventions of Dr. Guiseppe Musso tend to prove.



Above (Fig. 2) Illustrates the Small Difference Between Dr. Musso's (at left) New Submarine Cable Telephone Set and Ordinary Telephone (at right).

Below (Fig. 1) Portrays Dr. Musso's Highly Perfected Long Distance Telegraphic Recorder, Which Prints the Dots and Dashes on a Moving Paper Strip.



Many telegraph and telephone engineers are only too well aware of the difficulties encountered in the submarine cables, such as enormous inherent capacities, resistances, etc. Some companies have even gone to the extent of developing a new cable with which to reduce the large amount of capacity, and thousands of dollars have been expended in this direction, but very little headway has been made. The longest talking distance ever covered with a submarine cable was 31 miles. Also the incoming speech waves were so indistinct that it was practically impossible to reproduce articulate conversation.

However, with this latest invention of the Italian scientist, the Government has recognized that greater distances can be covered and has tested the apparatus with an actual submarine cable in Alaska, which carried successfully speech over a distance of 320 nautical miles. Arrangements are now being made for greater experimentation along this line, and distances up to 3,000 miles have actually been covered with an artificial line, as partly illustrated in Fig. 1. This consists of lumped inductances and capacities mounted on the wall.

The various condensers on the wall represent the capacity of the usual cable. By changing the circuits various artificial cable lines can be obtained. Fig. 2 shows the difference between the present telephone (at the right) and Dr. Musso's long distance submarine cable telephones. No additional apparata is required, with the exception of those illustrated here.

Dr. Musso has also turned his inventive brain to the development of a high speed submarine cable telegraph apparatus. The receiving apparatus of the recording type is shown at Fig. 2 on the table in the foreground. Messages can be recorded with much greater rapidity than that with which the human hand is capable of writing; the signals being automatically notated on a strip of paper, as perceived.

BLIND WIRELESS OPERATOR.

J. William Ellis, of Lakewood, said to be the only blind wireless operator in the world, opened a wireless telegraph station at Rocky Point, R. I., recently for exhibition and transmitting purposes. The antennae extends from the Rocky Point tower to the cupola of the hotel, the station being in the tower.

All kinds of commercial and naval messages were received, including those from outgoing and incoming steamers all over the coast from Canada to Guantanamo Bay, Cuba. Visitors are invited to the station to watch Mr. Ellis operate.

Mr. Ellis has been engaged in the wireless operating business for 10 years, for the last eight years as builder and manufacturer of all kinds of receiving and sending wireless apparatus. He was a commercial operator eight years ago at the Waldorf-Astoria Hotel in New York, and has also operated for the New York Association for the Blind and the Metropolitan Opera House. He has also controlled and operated a large receiving station at Lakewood.

Wireless apparatus that weighs but eight pounds yet will transmit messages 21 miles and has received signals more than 300 miles has been invented by a New Jersey man.

ELECTRIC PONY SHOOTS SPARKS

Many spectacular adaptations have been made for several years past of high frequency electric currents on the theatrical stage, with great success. But the ever active, quick-witted minds of theatrical performers have now discovered a new scheme for attracting and holding the interest of the public in the application of these high frequency currents to animals. At first it appeared as if this new idea would never be successfully produced, as in many cases the animal would become electrocuted by the current, or the shock would prove sufficient to make the animal uncontrollable.

However, after long, persistent practise and training Mr. La Reine has succeeded in applying these high voltage currents to a pony which is now able to withstand the shocks without any outward or visible sign of emotion.

The illustration herewith portrays Mr. La Reine and his pony performing a stage act known as "The Electric Pony." The animal is charged with high voltage electricity, produced by a Tesla coil, and various interesting electrical feats are enacted, such as drawing sparks, lighting paper from any part of its body, and many others. The act is intensely interesting to the audience and the effect very spectacular.

The Pony That Shoots Forth Electric Sparks for the Amusement of Theater Audiences.

Enameled Magnet Wire, Its Properties and Manufacture

By L. Earl Deane

THE older readers of this article will probably remember that in Franklin's time electricity was not considered as it is now, nor did the Philadelphian have the modern conveniences with which to conduct his experiments. Annunciator wire was not used to conduct the current to the key, nor was a toy motor, such as a Knapp or Loomis, used to wind in the kite. One is caused to wonder, when he stops to think of the marvelous advance within so short a time, in every phase of electrical progress.

Electricity in the time of Franklin was considered an uncontrollable atmospheric discharge. Later it was found to have been wrongly considered and was called a fluid, because it apparently flowed, as did water, through certain mediums. Now we think that we have it boiled down to a vibratory motion of the molecules or etheric electrons.

Knowing that electricity traveled with varying degrees of strength and velocity through different mediums, it became necessary to "insulate" the conductors, to interpose some substance between the conductor and other conductors, so as to prevent "leaks." Such a substance was said to possess a "dielectric" quality. Silk and cotton, being found low in the scale of conductors, came into universal use. Coils were wound for individual use, no attention being given to another's problems.

It was known that certain laws existed concerning fixed relations between the number of turns on a coil, size of wire used, resistance of winding, current consumption and work to be performed. It was also known that these relations varied with the thickness of *insulation*. The problem then was to get at the basic principles, formulate them, and arrive at some standardized results which would prove of practical value. Engineers became interested. The old forms of insulation were unsatisfactory for several reasons: They occupied too much space; broke down under moderately high voltage; would not withstand high temperatures; absorbed moisture; and disintegrated under the action of acids.

Showing Relative Volume of Various Kinds of Insulated Magnet Wire. Note Small Space Occupied by the Enameled Wire.

Thus you see the great problem which the inventors and experimenters in industrial chemistry had to attack. A covering was to be found which would occupy less space than does a single silk thread. High tension currents must be carried safely. It must withstand heat, both external and internal. It must be impervious to moisture and inert to chemical action. It is not necessary, if I could indeed do so, to relate all the difficulties encountered. Suffice it to say, the first producers of enamel wire placed on the market a form of insulation —an enamel—which met all these requirements and was also elastic enough to be practicable.

As to the voltage test on such enameled wire, I will give the result of a recent experiment performed by Prof. A. B. Smith, of Purdue University. A three-foot length of No. 36 B. & S. wire stood the following voltage tests before puncturing:

Enamel, 736 volts; single cotton covered, 587 volts; single silk covered, 527 volts. Thus you see the advantage of enamel over fabric covers as to danger of electrical breakdowns.

As to the space occupied the following tables show the great saving in enamel over the older insulations, as to number of feet per pound and outside diameters of various covers.

WIRE, APPROXIMATE FT. PER LB.

B. & S. gauge.	Single cotton.	Single silk.	Enamel.	Bare wire
24	763	799	810	818
27	1,500	1,584	1,620	1,639
30	2,860	3,148	3,240	3,287
32	4,234	4,913	5,132	5,227
35	7,755	9,536	10,197	10,480
40	18,376	26,558	32,107	33,410

OUTSIDE DIAMETERS.

B. & S. gauge.	Single cotton.	Single silk.	Enamel.	Bare wire
14	.0686	.0661	.0660	.0641
20	.0365	.0340	.0333	.0320
27	.0182	.0162	.0152	.0142
35	.0096	.0076	.0061	.0056
40	.0071	.0051	.0034	.0031

The above tables show enameled wire to be in close proximity to bare wire. The importance of this is best shown by the law of comparative activity: *The activity of a coil winding varies directly as the ratio between the cross sectional area of the conductor and that of the conductor plus the insulation.* To make it plain, the closer the winding lies to the core the greater the strength of the magnetic field, and enameled wire brings the turns closer to the core because the insulation is thinner.

Enamel is guaranteed to withstand a temperature of 500° F. provided the coil is allowed to cool before being moved. I have seen cases where the test was much more severe than this, but a conservative guarantee is 500°.

Internal heat, whether by normal or abnormal currents, is diffused by enamel, so that the proper working temperature of the coil is more easily obtained and maintained.

Enamel is not affected by moisture, water, oils or greases, nor is it injured by chemical action. Gases and fumes, so often encountered, do not injure enamel.

Mechanical strength, twists, turns, etc., may best be proved by actual test. Enamel will stand far more abuse than will fabric covers. It may be stretched without opening the insulation, as will fabric.

The combination covers, cotton or silk wound over enamel, afford the same advantages as enamel, with the additional protection for voltage or to serve as a cushion in cases where it is necessary because of mechanical difficulties, friction, abrasion, jarring, etc.

Fig. 1 (at left) Shows Machinery Used in the Manufacture of Enameled Magnet Wire. Fig. 2 (above) Illustrates Part of the Finishing, Winding and Inspecting Department.

With the fact that less wire in weight, in enamel stock, is required than in fabric covers; that it costs less by the pound than any fabric; and that there are more feet to the pound than in the fabrics, the greater saving is evident.

The process of manufacture is depicted partly by Fig. 1. This shows the process as used by the American Enameled Wire Co. The bare wire runs from the spools, S (there is a table, T, on each side of the oven, so that twenty wires run through each machine, ten on a side), over the pulleys, P, through the enamel tank, E, which is heated by an electric heater. From there it runs vertically through the oven, O, where it is baked at the proper temperature. Gears, F, drive fans to keep the temperature even throughout the oven. Each machine is also connected to a blower pipe, which serves as an additional equalizer of oven temperature. This process is repeated five times, five coats on a wire, even down to No. 40, which measures .0034 inch outside diameter. Each coat is baked hard separately before the next coat is applied. The finished wire runs off on to spools at W.

From the enameling room the wire goes to the inspection room, Fig. 2. Here every inch of wire is inspected by experts before it leaves the plant. Any defective spots are cut out and the wire is welded and enameled at the weld, leaving no joint or large place. The weld is not weakened and cannot be detected from any part of the wire.

Despite the most careful precaution in enameling some defective wire gets through to the inspectors. The power plant is governed so as to keep a uniform speed on the machines. Machine shafts are con-

trolled for the same purpose. All working rooms are kept at a constant temperature. The machines are "boosted," so that even the very fine sizes of wires are not stretched in running through as many times as they do. Pin holes, burnt or raw enamel, rough spots, lack of uniformity in size, etc., must be noted and detected by the inspectors. Wire must measure to size or it is rejected. The finest possible instruments are used for this, measuring directly to .0001 inch.

From inspection it is sent to the main shipping room, where it is boxed and sent to all parts of the world.

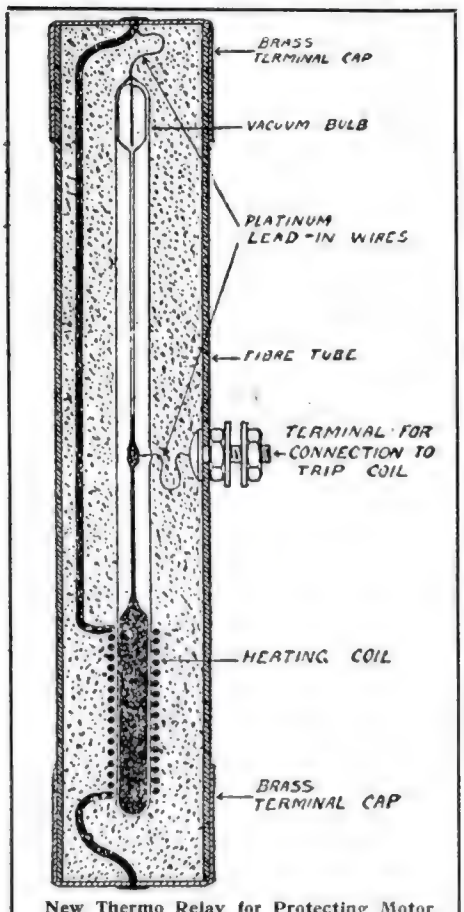
Just another point before quitting the issue—do not hesitate to ask the manufacturers for information. Some one often asks me how to clean the wire for terminals, etc. The maker of the wire which you use can give you a tip on this that will be worth asking for. Suggestions as to binders, etc., are sometimes desirable. Do not be afraid to ask what you want to know. In all probability the engineers of the wire company can help you, and if not they will be willing to tell you so and no harm will be done by communicating with them.

(Copyright, 1914, by L. E. Deane.)

NEW THERMO-RELAY FOR MOTOR PROTECTION.

A very ingenious and undoubtedly efficient electric motor protector, similar in size to the usual cartridge fuse, with which we are all familiar more or less, is shown in the sectional view here depicted.

The principle of this device, known as the "Thermo-Relay," is based upon the fact that if a small coil of wire, forming a heating coil as our illustration shows, is placed



New Thermo Relay for Protecting Motor Circuits.

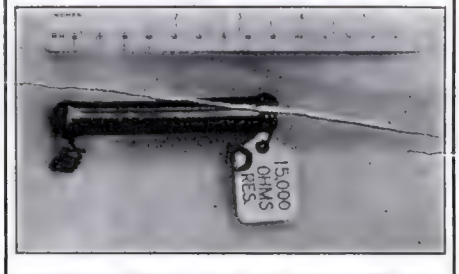
around the base of a glass tube, similar to a thermometer tube and which contains some mercury, then when a certain current passes through the circuit (and consequently through the heating coil which is in series with the main motor leads) the mercury will gradually rise. Now when a certain predetermined amount of amperes passes through this device, the mercury will rise high enough in the tube to close a trip coil circuit through the binding post in the side of the tube, as indicated.

The trip coil acts the same as a circuit breaker coil, of course, and opens the switch, thereby cutting off the current supply to the motor. This device evidently is extremely practical and sturdy in its operation, as the manufacturers of the same offer $100 to anyone who can burn out a motor properly protected by the use of these Thermo-Relays in the main circuit.

NEW COMPACT RESISTANCE UNIT.

Herewith is a photograph which shows a new and extremely compact resistance unit 7/16 inch in diameter by 3½ inches long.

This resistance unit has 15,000 ohms of resistance on one layer of wire. The wire is so fine that it would be crumpled up in two or three days if left open to the atmosphere with no current passing through it, but it is covered with a vitreous enamel insulation which protects it from the oxidizing influence of the atmosphere, causing it to last an unlimited length of time.



Smallest "High Value" Resistance Made.

This tube is interesting. It is a porcelain tube with wire wound upon it and covered with a vitreous enamel which entirely encloses it and protects it from chemical, mechanical and electrical deterioration. It is doubtful if a unit of half this resistance, or even a third of this resistance, has ever been produced, in this space, on a single layer of wire, up to a short time ago.

POWERFUL NEW CHINESE RADIO PLANT.

Arrangements have been completed for the erection of a wireless installation at Foochow at a cost of $15,000. The plant is to be of the Telefunken style, with an A. E. G. (German) dynamo of 12 kilowatts, converter and a gas engine of 28 horsepower. The storage batteries will be charged from the dynamo; the converter, being operated by the storage batteries, will make an oscillating current of 500 cycles. Two wooden masts are to be erected, each 200 feet high. The guaranteed range is 1,500 miles at night and 650 miles in the daytime, although it will be possible to secure a range of 2,000 miles and 1,000 miles, respectively.

The wireless station will be operated in connection with and under the control of the Chinese Government telegraphs and will be devoted chiefly to military use. Public messages will, however, be sent and received to and from ships and the wireless stations already erected at Shanghai, Canton and Wuchang. Wireless plants have now been erected or are in process of construction at Shanghai, Canton, Peking, Kalgan, Wuchang and Foochow. Four more stations are to be installed, two of which will probably be at Yunnanfu and Chengtu.

ELECTRIC ILLUSION SIGN FOR BARBERS.

A very attractive electric illusion sign was recently perfected and put in operation for a New York barber. The sign herewith illustrated consists of a circular disc of glass and having three colors; red, white and blue painted on it, as shown.

Novel Electric Illusion Barber Sign.

This disc is rotated at medium speed by a small electric motor connected to the shaft of the disc by means of a leather belt. When in operation various novel effects are produced by the constantly changing colors, which never fail to attract the eye of the passer-by. This sign is one of the well-known Federal line.

IONOMAGNETIC ROTATION.

A. Righi finds that a body turning lightly on an axis and placed inside a gas suitably diluted and ionized (for instance, by means of sparks) will commence to rotate around its axis as soon as a magnetic field is created in the direction of the axis. This phenomenon the author has called ionomagnetic rotation. He explains it as follows: It is known that the path of an electrically charged particle (ion or electron) changes when a magnetic field commences to act, and when this field is uniform the path becomes a helix with its axis parallel to the field. The sense in which this curve is followed is identical with the sense of the current flowing in the coil producing the field when there are negative ions or electrons; the sense is the opposite when there are positive ions. So when there exists a magnetic field the ions and the electrons will follow helical areas instead of straight paths.

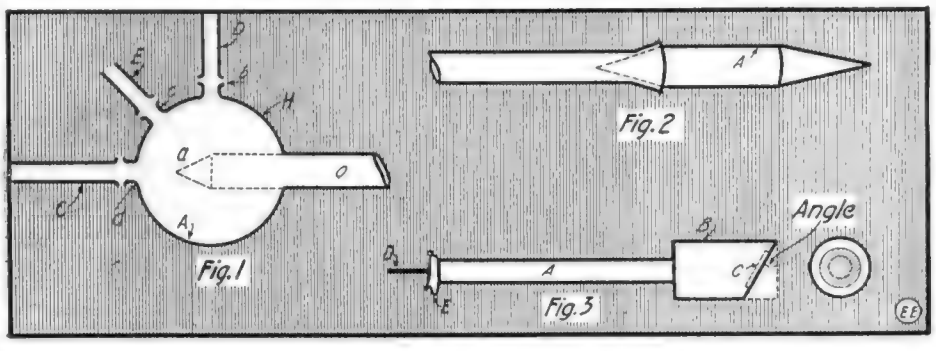
Owing to the action of the magnetic field they will be directed all in the same sense and all around the body, thus producing the rotation of the latter. This will occur in the same sense as the current producing the field in the case of positive ions, and in the contrary sense in the case of negative ions. As the couple changes sign with change in sign of the electric particles, the ionomagnetic rotations will be generally produced by the difference of two couples of contrary signs. At the beginning of these researches the author was for long in doubt whether the rotations observed could be explained by the actions of the ordinary electromagnetic forces. Finally he has been led to conceive that the well-known forces which provoke the movement of a conductor through which an electric current is passing, when other currents or a magnetic field are acting, are the result of the shocks of the electrons which, accaccording to modern theories, move in the interior of the conductor and constitutes the current.—Abstract from *Atti Asso. Elet-Italiana* in *The Electrician*, London.

X-Ray Tubes and Their Manufacture

By Samuel Cohen

IT was not until after the discovery of the phenomena of the X-rays by Wilhelm Konrad Röntgen that the world realized the value of these powerful penetrative rays. Many articles have been written on the theory of X-ray tubes, but none of these tell how the tubes are made. It is the intention of this short article to show the reader how these tubes are manufactured.

One of the first operations consists of blowing out the bulb A, Fig. 1. This is done by closing a glass tube O at point (a) and heating it to redness. When the operator sees that the glass is heated to the right temperature he then slowly and carefully blows into the open end of the tube, which expands the hot soft portion of the tube at (a), and by blowing constantly and turning the tube in the flame the bulb A is formed. After the bulb is blown to the proper size the holes b, c, d are next made. This is done by heating the glass at the indicated points with a sharp blow flame and then blowing into the neck, which forces the soft heated parts out. A small projection is made on the holes as shown; the purpose of these projections will be seen later. All the blowing of the glass is done by the operator, and no compressed air is utilized.



Various Stages in Manufacture of X-Ray Tubes.

Expert Glass Blowers Are Employed Only in Making the X-Ray Tubes.

The electrode glass tubes are next made. They consist of a glass tube of proper dimensions, and on one end of these tubes a small flared portion is made. This is done by heating one end in a flame and introducing a conical piece of charcoal, as shown in A, Fig. 2. The projection of the hole in the glass bulb and the flared end of the electrode glass tubes (c, Fig. 1) are now welded together; they are heated simultaneously in a brush flame, that is, a pointed flame, and jointed while quite soft. The joint is made true and even by constantly turning the tube to keep the glass evenly heated. All the electrode tubes are welded in the same manner.

One of the electrodes consists of a tungsten alloy disc C, Fig. 3, welded in a solid copper rod B. A cylindrical iron tube A is used for supporting the target C and copper rod B. Extreme care is taken in making the proper angle on the copper rod as shown. The deflection of the X-rays depend wholly upon this angle of the tungsten target. A short piece of platinum wire D is next welded to the iron cylinder A. A small quantity of soft glass E is now poured on the end of the cylinder. The electrodes G and F (Fig. 4) are made in the same way, but consist only of aluminum discs instead of the tungsten.

The next process is to weld the electrodes to the tubes C, D, E, Fig. 1. The electrode is placed inside of the tube, and the end of the glass tube is heated to redness. It is now closed and a small hole is made by forcing a piece of glass through the soft portion. The platinum wire is now passed through this hole and the end is again heated. The glass on the end of the electrode E, Fig. 3, welds together with the end of the glass tube and it is thus sealed up. The weld is made smooth and true by constantly turning the end in a flame and blowing through end H (Fig. 4) until the end is perfectly sealed. The other electrodes are sealed in the same way.

The tube is now ready to be exhausted. This is accomplished by connecting the small open tube H, Fig. 4, to an exhaust or vacuum pump, which may be a mercury, oil or molecular exhaust pump. After proper vacuum is obtained the glass tube H is sealed, while the pump is exhausting the tube. This is done in order to prevent any air entering the bulb. Names and trade-marks on these tubes are made by the etching or sand blast process. The location where the name is to be etched is inserted in a solution of boiled common wax and allowed to dry. The name is next marked out in the wax and then dipped into hydrofluoric acid, which dissolves glass. The etching continues for a few minutes and then the tube is rinsed in clear water. The wax is now removed, allowing the neatly etched letters to remain.

The main difficulty in the manufacture of X-ray tubes is in the glass work, and therefore expert glass blowers are required. The day will come, perhaps, when someone will invent a machine for blowing glass bulbs automatically, which will reduce enormously the price of X-ray tubes.

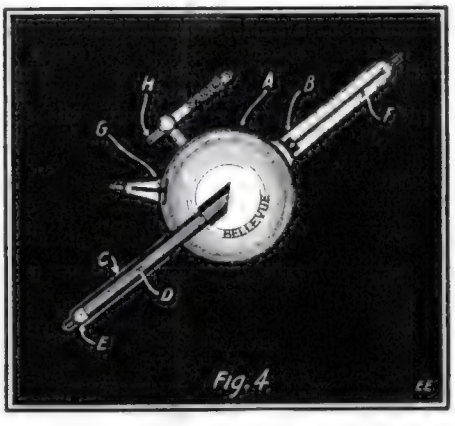


Fig. 4. Showing the Different Parts of X-Ray Tube Assembled.

At present all the work in making X-ray tubes may be said to be hand work and thus the expense is severely high.

A BATTERY TYPE MAGNETIZER.

By Frank C. Perkins.

The accompanying illustration shows an effective battery type magnetizer of the Swedish-American type developed at Chicago, Ill. It is pointed out that magnets should always be kept fully charged. All magnets lose their strength in time, and this results in decreased efficiency of whatever device they are used on. This holds true of telephone apparatus, automobile, motorcycle and motor boat magnetos, charging and lighting generators.

In telephone apparatus weak generators, receivers or ringer magnets will render satisfactory service impossible, and in magnetos for gas or gasoline engines a fully charged magneto with "saturated" magnets gives a much fatter, hotter spark than one whose efficiency is lowered by weak magnets.

New Portable Type Magnetizer for Recharging Magnets.

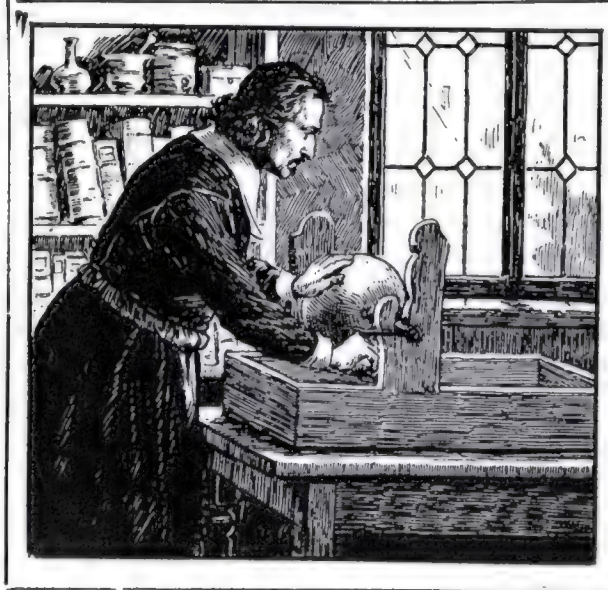
It is recognized that sending of the magnets to the manufacturer to be remagnetized causes long delays and considerable expense, and they are often demagnetized or broken in transportation. These difficulties can be eliminated by using a magnetizer of the type illustrated in the accompanying photograph, which is efficient, durable, compact, sturdy and easy to operate. It requires no experience to "charge" magnets, and it will operate on five ordinary dry cells or a 6-volt storage battery or on 110-volt direct-current lighting circuit.

It is quickly adjustable to any size or shape of magnet. It is equipped with a switch which automatically cuts off the current. Less than half a minute is required to fully energize or "remagnetize" any magnet. Thus this device saves both time and money.

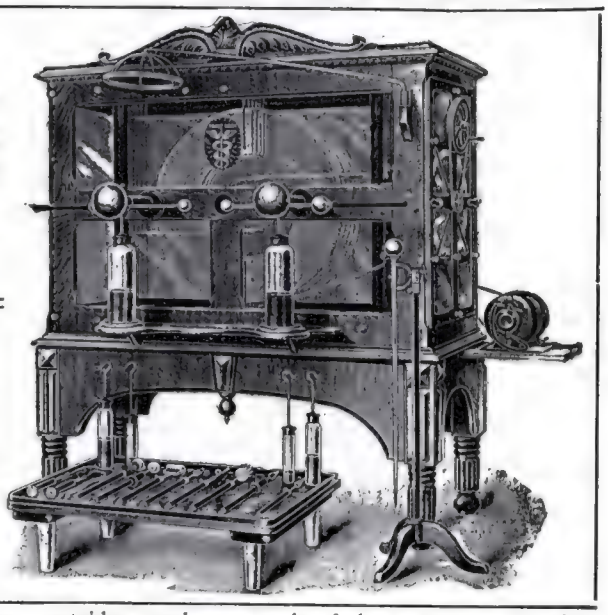
The Static Machine, Past and Present

THE large static machines, or for that matter even the smaller ones in use to-day, are quite efficient indeed and a wonderful improvement over the first attempts made in producing static electricity.

The earliest form of electrical generating machine of the static type was that devised by Otto Von Guericke, of Magdeburg, Germany, in the year 1630. His machine consisted of a globe of sulphur fixed upon a rotatable spindle, so that it could be turned around rapidly by means of a crank, and static shocks were obtained from this crude device by pressing against the surface of the sulphur ball with the hand while it was being turned.



At Left, Fig. 1, Is Seen Otto Von Guericke, the Earliest Worker in the Field of Static Electrical Machines and Also His First Crude "Sulphur Ball" Static Generator Made in the Year 1630.



At Right, Fig. 4, Illustrating the Latest Model Multiple Glass Plate Static Machine, with Driving Motor. It Will Develop Heavy Sparks 20 Inches Long of Great Electrotherapeutical Value.

With this simple arrangement Von Guericke discovered the existence of small electric sparks and the peculiarity of static electric charges. This sulphur ball machine and Von Guericke himself are seen in illustration at Fig. 1, while Fig. 2 shows some of the experiments being made with this crude static generator. The boy hanging over presses against the sulphur ball with his feet and transfers the static electricity to the young lady by means of his hands as depicted. Note the electric attraction of the small bits of paper from the table on the extreme left.

Later Sir Isaac Newton, of England, replaced the sulphur ball utilized in Von Guericke's machine by a globe of glass. At a later period the general form of the machine was improved from time to time by several German electricians, notably Von Bose, who added a collector or "prime conductor" in the shape of an iron tube, held by a person standing on cakes of rosin to insulate him from the ground, or else the collector was suspended by silken threads. Also Winckler, of Leipzig, substituted a leather cushion for the hand as a rubber, and Gordon, of Erfurth, rendered the static machine more easy of construction by making use of a glass cylinder instead of a glass globe. The electricity in this case was led from the excited cylinder or globe to the prime conductor by a metallic chain, which hung over the globe. A pointed collector was not employed until after Franklin's famous researches on the action of points with respect to electric charges.

About the year 1760 De La Fond, Planta, Ramsden and Cuthbertson developed machines using flat glass plates instead of glass cylinders. Fig. 3 shows a static machine built by Martinus van Marum, in 1785, utilizing the glass plate principle. The machine consisted of two glass plates 23 inches in diameter and 7½ inches apart. The sectors were 15½ inches in diameter and were made of sheet copper. The glass standards were 57 inches high. When this generator was in operation it only developed a thin spark 8 inches long and a brush discharge in the dark of 21 inches. The two plates were operated by means of a large crank shown at the extreme left and designed for two men.

From that time on the principal modifications and improvements in the static machine have been along the line of the substitution of ebonite or hard rubber, and in some cases patented compound mixtures instead of glass for the rotating plates have been employed. Further improvements have been made in the invention of compound machines, depending upon the principles of induction and convection.

A modern type of static machine capable of giving steady and powerful sparks 20

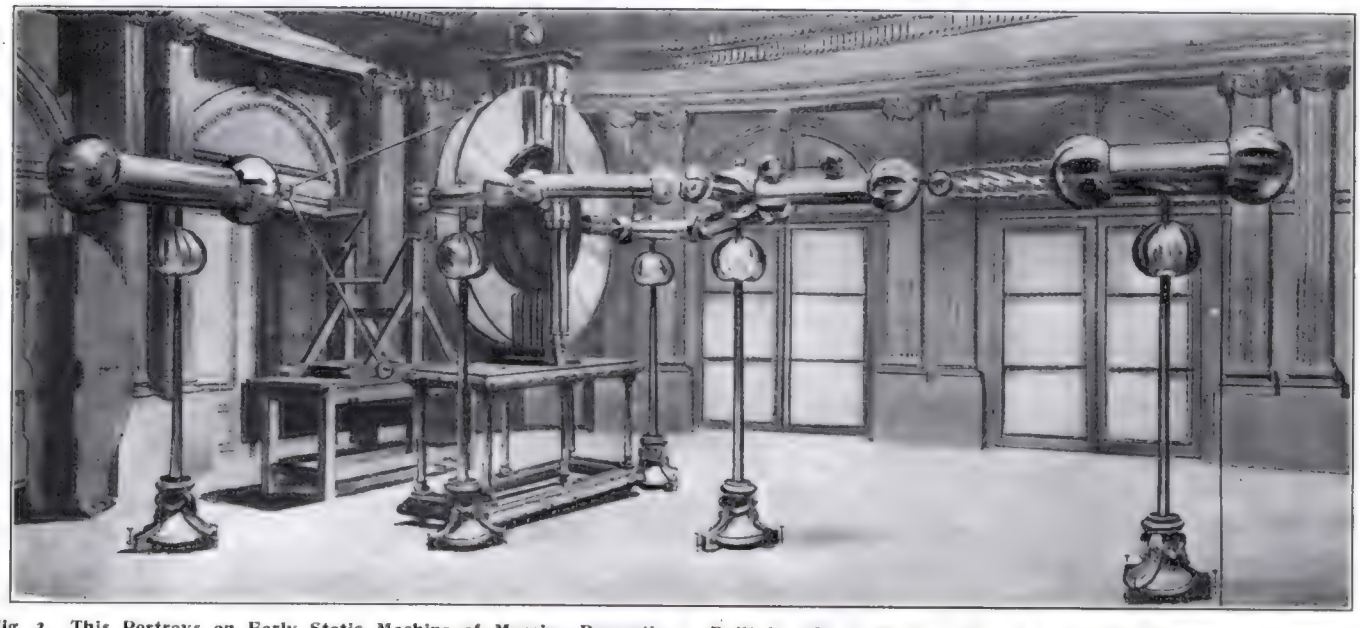


Fig. 3. This Portrays an Early Static Machine of Massive Proportions, Built in 1785 by Martinus Van Marum. This Ponderous Machine Standing 10 Feet High, Produced But 8-inch Sparks.

inches long is shown in Fig. 4. This machine has a multiplicity of large rotating plates, and also makes use of Leyden jar condensers to increase the activity or volume of the discharge between the smaller brass balls observed on the side of the machine. This powerful instrument is driven by an electric motor and is much used for physicians' requirements. A complete set of various electrodes for treatment work is shown on the insulated glass foot stand. The static machine is of low over-all efficiency and is being rapidly substituted by modern high-voltage transformers and spark coils.

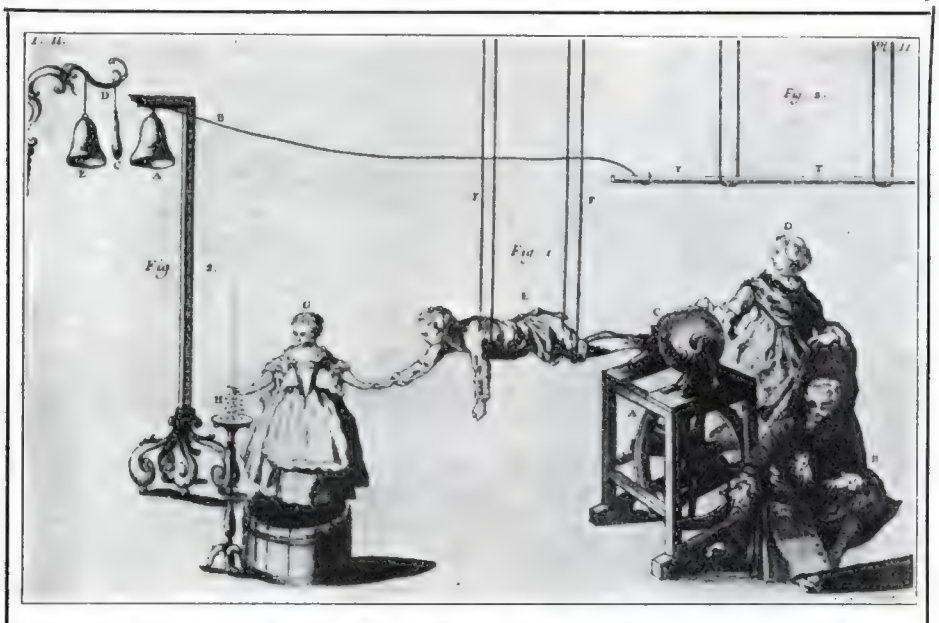


Fig. 2. Experiments with the Early Static Electric Generators Were Mostly Carried Out With a "Human" Prime Conductor as Here Shown.

OZONIZER HELPS FISH CANNERIES OF EUROPE.

New uses for electricity are being discovered every day. Even in war-swept Europe ways and means are being devised whereby electricity is employed to lighten labor and to improve working and living conditions. One of the latest and most novel applications is the use of Westinghouse electric ozonizers to reduce the odors usually prevalent in the fish canneries of Norway and Sweden, which, as is well known, supply a large part of the world's needs and form one of the chief industries of those countries.

Several months ago 50 of these devices were installed in the canning factories that line the coasts of Norway and Sweden, and their success was so marked that orders were immediately placed for approximately 130 additional ones, which will soon be in operation.

An ozonizer is a device that converts part of the oxygen in the air into ozone, which is nothing more than a modification of oxygen, having increased chemical activity. It has properties similar to those of oxygen, but to a more marked degree. It is a strong oxydizing agent, and, therefore, attacks organic material, such as germs, bacteria and the small organic particles that produce odors. It is this property of being able to destroy odors that has made the ozonizer so popular in the canning factories, and it is claimed that, while its use does not entirely eliminate the strong odors attending this work, it reduces them so they are not objectionable. By doing this it greatly improves working conditions, making them more pleasant and more sanitary.

Ozone is produced naturally by lightning discharges, by the slight electric effect produced by the separation of particles of spray from waves and waterfalls, and by some other of nature's processes. The manner in which it is produced electrically is interesting. A current at high voltage is applied to the inside and outside coatings of specially prepared glass cylinders and minute brush discharges take place over the inner surface. These tiny discharges act on the air in the cylinder or tube and change part of the oxygen in the air into ozone.

WHEN EDISON GOT MARRIED.

Although it is a fact not generally known, Thomas A. Edison, the master inventor, was so engrossed in his electrical researches at the time of his marriage in 1873 to Miss Mary Stillwell, that at the appointed hour when the minister was to pronounce the ceremony, the guests were unable to find Mr. Edison for some time.

Finally he was located in his private laboratory, experimenting with the electric light, which was in those days, of course, a great novelty, and, in fact, a brand new branch of science.

Our illustration herewith reproduced from an old print shows this episode in Edison's life and follows in many ways a number of other incidents which have occurred during his strenuous career.

It is recorded that at one time he had presented to him a box of "Havana" cigars, and although they were of doubtful quality he in a very short time had smoked the whole box of them. Absent mindedness such as this is an attribute of the greatest scientists of the world. When walking about his extensive laboratories at West Orange, N. J., it is rarely that Mr. Edison notices anyone, whether they are callers or not, and he walks by even when close enough to brush their clothes with his coat. He does not recognize them even though they are old-time friends, as he is so intensely absorbed in thought over some invention or other.

Mr. Edison's wife has undoubtedly helped in a myriad of ways to make him the master inventor and scientist that he is to-day.

How Edison Was Married.

THIS MODEST INVENTOR WOULD STOP WORLD WAR.

"I can make the United States the strongest nation in the world. I can end the European struggle in a short time. I can make the smallest nation most powerful."

This is the assertion of John Vogelzangs, of Menominee, Mich., an inventor, who claims to have a method of extracting electricity from the air so that aircraft might be manned with powerful guns and not be forced to land until they want to.

"I can sweep the seas clear of vessels. I can kill armies and level cities," claimed the inventor, who in the same breath asserted he favored universal peace, but that the world was not ready for it.

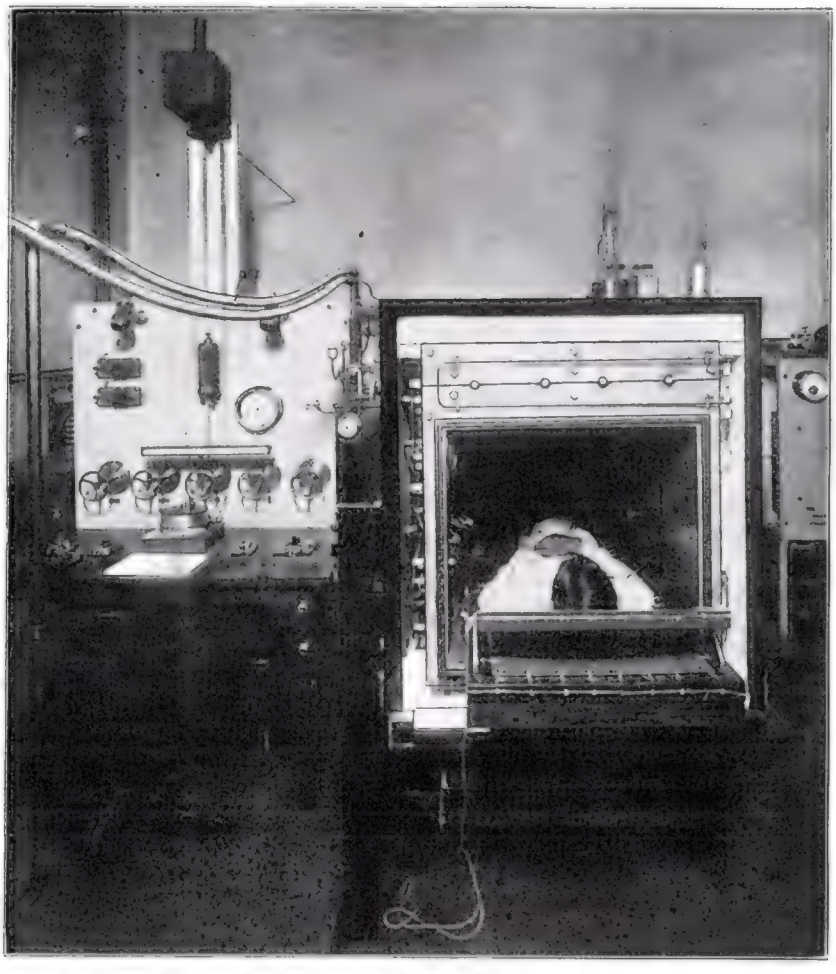
He says Secretary Daniels' plan for an advisory board is good. He refused to give out much information about his new device, and said he lacked money to carry on the work and displayed a letter from Mr. Daniels, written before the war broke out, saying this nation was not ready to take up his ideas.

Vogelzangs has a reputation for being an inventor of ability. He made a street cleaner which he refused to sell for $10,000.

New Calorimeter Registers Energy of Man's Every Move

A respiration calorimeter is an apparatus designed for the measurement of the gaseous exchange between a living organism and the atmosphere which surrounds it, and the simultaneous measurement of the quantity of heat produced by that organism.

The first contrivance of this nature was described by Lavoisier in 1780. It will be remembered that Lavoisier was the first to comprehend the significance of the then newly discovered oxygen. Primitive though the apparatus was, yet intellectually inspiring was the mind which so early grasped the principles and understood many of the difficulties.



Marvelous New "Human" Calorimeter Which Is So Sensitive in Its Adjustments That the Heat Generated by the Mere Raising of a Man's Arm Indicates on an Instrument.

In our illustration the large opening at the head of the box, into which a man can be slid, measuring 76x70 cm., is closed by two glass plates 7.5 mm. thick, each of them sealed after the subject has entered the calorimeter by means of a mixture of five parts of beeswax and one and a half parts of Venice turpentine. There are numerous pipes and electric cables entering the box for the various control devices, thermopiles, etc.

On the surface of the outer copper wall are attached the wires connecting up the thermopiles. The pipes for cold water are swung on brass angles attached to this surface, and the enameled "Therlo" resistance wire is bound on insulators to the same surface.

It is remarkable how promptly the spirometer (air-pressure gauge) rises when the person within the box makes even a *slight movement* of a hand or leg. In fact, it makes so delicate a movement record that a Porter *work-adder* has been attached in such a manner that the downward movement of a counterpoise weight winds up a thread, and the total amount of thread so wound represents the total work done by the patient during that particular period. By standardizing various movements of the body such as turning over or lifting the arm, it is possible to gain a fairly accurate idea of the amount of muscular movement and express it in centimeters of thread, thus obviating the necessity of printing long, graphic records. So sensitive is this machine that an ordinary telephone is not adaptable for use inside the chamber if a man has to make any movements at all, so a dictagraph with super-sensitive microphone is utilized to convey the subject's speech outside.

The thermopiles between the outer and inner copper walls of the chamber are arranged in three groups, 32 on the top, 30 on the sides and 12 on the bottom, the area covered by each group being warmed by a strand of enameled "Therlo wire," No. 24 B. & S. gauge, whose temperature is controlled by one of the adjustable rheostats.

One thermopile is arranged with one end in the outgoing air current and the other in the ingoing air. The temperature of the latter is adjusted to that of the former by means of a step rheostat and two 55-volt lamps. A similar rheostat controls the temperature of the ingoing water by means of a water-heating resistance.

By carefully controlling the rate of flow and the temperature of the water in the heat absorber it is possible to adapt this calorimeter to wide variations in the heat production of the subjects. For example, on April 23, 1914, an experiment was made on a cretin, with an average heat production of 26 calories an hour. The next day the subject was a patient with exophthalmic goiter, whose heat production averaged 107 calories. In one case the methods of direct and indirect calorimetry agreed within 0.2 per cent. and in the other within 0.7 per cent.

BOOK REVIEW.

"Practical Applied Mathematics," by Jos. W. L. Hale, S.B., E.E. Cloth covers, 206 pages, 185 illustrations. 5x7 inches. Price $1. McGraw-Hill Book Co., New York, N. Y.

A useful handbook on applied shop mathematics starting with the rudiments of arithmetic and leading up to the mensuration of solid and plane surfaces, cube root, practical use of graphic curves, simple binomial equations in algebra, etc. The treatment of each subject is unusually clear, showing in a very practical manner the relation betweeen mathematics and everyday problems, such as locomotive and car weights, strains, etc., tank and other volume calculations, micrometer readings, measurement and relations of angles, circles and spheres. An appendix of very useful tables is added to the book. This book may be recommended to anyone desiring to read up on practical applied mathematics and their adaptation to everyday shop problems.

Radio Stations of the World, compiled by A. Coleman and J. B. Harrietts. 200 pages. 5½x3 inches. Cloth covers. Vest pocket edition, 60 cents. Published by Radio Stations of the World, New York City.

This new radio call book contains in alphabetical order all of the official call signals which are arranged in such form that upon hearing a stations letters one can instantly find the name, nationality, etc., of the station to which that call has been assigned. The names of ship and shore stations are also arranged alphabetically in another section, which also gives the call letters. It also contains the international abbreviations (Q signals). It includes every merchant, government and naval vessel, the high and low power, commercial, government and private land stations of the entire world, both of countries which have and have not agreed to the radio-telegraphic conventions.

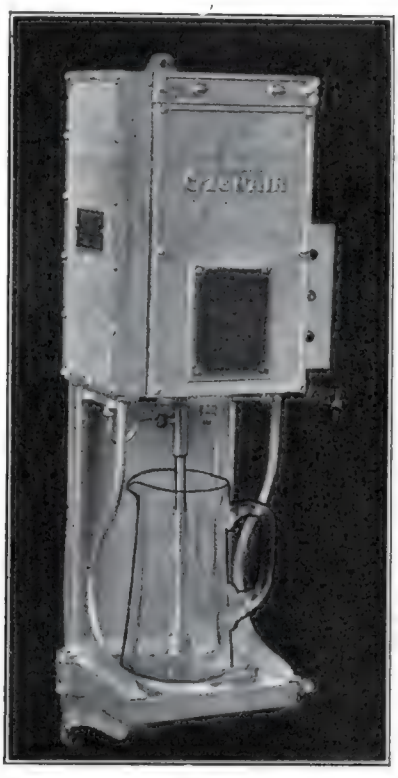
It is very handy and is claimed to be the only complete list of international radio stations and calls that has ever been placed upon the market. The book is printed in special clear type, on good quality paper, neatly bound in black cloth, stamped in gold, and fits the vest pocket. It should find a ready sale among all radio operators, both amateur and professional. Supplements are furnished to keep the work up to date. Also blank call pages are inserted to allow of filling in newly assigned calls in their proper relation.

SURGEONS USE ELECTRIC SAW.

Sawing bones by electricity instead of by the old hand method is now all the rage in surgery. It saves labor and makes for accuracy, and soon the suffering public, hearing of the latest, up-to-the-minute methods, will demand that when it must have its skull trepanned or the vertebral tibia sawed off, the job be done according to the latest styles in science.

NEW ENGLISH WATER OZONIZER

One of the most important details relating to the well-being and health of any community must be a pure water supply; pure not only as regards innocuous suspended matter, but free from the germs



Improved English Ozone Water Purifier.

of such dangerous disease as cholera, typhoid, dysentery, etc. These scourges more often than not are caused by the contamination, accidental or otherwise, of the supply of water at its source or during its passage to the place of distribution.

Fortunately, there are several methods at hand by means of which these defects can be easily and cheaply remedied.

The simplest and most certain in its action is sterilization by ozone. Ozone is the ideal agent for water purification. It accomplishes its purpose without in any way altering the natural constitution of the water and at the same time leaves no trace of its presence. Water which previously was alive with dangerous organisms will, after proper subjection to ozone treatment, be in perfect condition for consumption. Moreover, its appearance and odor will have been improved, and it will have a sparkling brightness which, before the treatment, was absent.

A neat and efficient type of domestic Ozonair (British) sterilizer of this type, and using 45 watts of current, is here depicted. It has a capacity of 30 litres of water purified per hour.

Edison Heads New U. S. Navy Science Board

At last the American naval authorities, in the personage of Secretary Daniels, have awakened to the fact that battles of today, unlike those of yesterday, are really fought by scientists, either directly or indirectly. More and more it becomes apparent to even the layman that science, properly directed, can effect wonderful results when it comes to naval and particularly *land* battles on the scale upon which they are waged in this era.

Particularly is this noticeable in the reports from Europe, which state that the Germans are now using several kinds of highly poisonous gas guns, as well as gas bombs. But not only in the mechanical, but particularly in the electrical and wireless branches of science, are there most wonderful opportunities awaiting development.

To further the scientific development of military arms and devices in America, Secretary of the Navy Daniels recently sent out invitations to a number of the leading inventors and scientific men of the country. Thomas A. Edison, the peer of all inventors, has been selected to head the board of nationally famous inventors, which will include such men as Henry Ford, Simon Lake, John Hays Hammond, Jr., Orville Wright, etc.

The photograph herewith shows Mr. Edison and Secretary Daniels upon the latter's recent visit to Mr. Edison's home at West Orange, N. J., when plans were discussed.

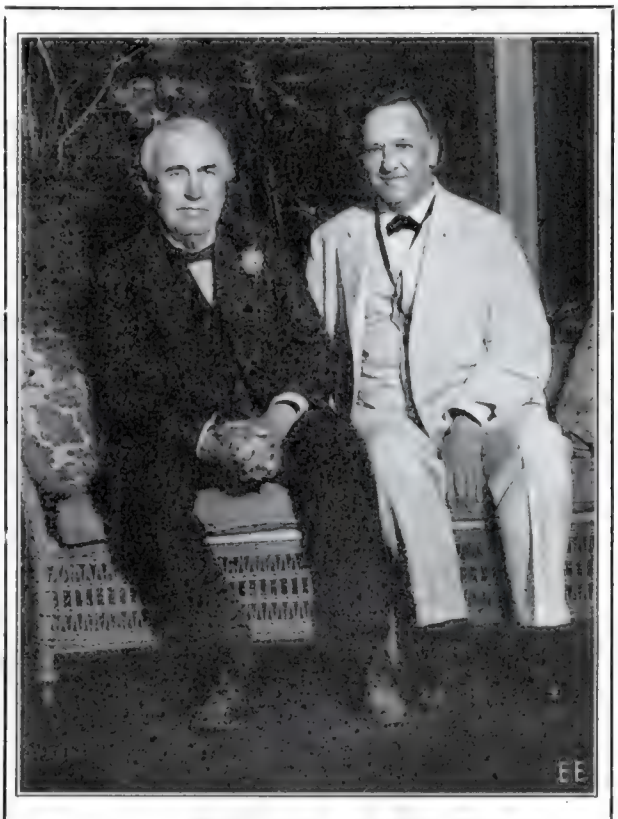


Photo (C) by International News Service.

Thomas A. Edison and Secretary of the Navy Daniels at Their Recent Discussion on the New Navy Science Board.

THE WIRELESS TORPEDO IN THE "MOVIES."

The wireless torpedo, which has been heralded far and wide as the greatest engine of destruction ever invented by man, has been exploited of late in the Pathé film, entitled "The New Exploits of Elaine," episode "Shadows of War."

The illustration herewith shows the new fangled wireless antenna invented by "Craig Kennedy," the master scientist of this remarkable film story. In the photo are shown his assistant and also the heroine of the story in the person of Miss Pearl White. "Craig Kennedy" is seen holding the miniature wireless torpedo which possesses remarkable devastating powers, and in the series of pictures it is demonstrated how, quite like the "Hammond" wireless torpedo, it is possible to send out wireless waves from the radio apparatus and antennæ, as here shown. These waves will cause the little torpedo, carrying terrible explosives, to be directed toward a hostile war vessel and as soon as it comes in contact with the hull of the vessel it, of course, explodes with mighty violence, blasting its target into eternity.

Love, intrigue and science permeate this extremely interesting photo play, including efforts by a foreign government to procure the secret of this wonderful radio torpedo.

Pathe Film Episode Exploiting the "Wireless Torpedo."

cussed for the formation of the new Navy Board of Invention and Development. The idea will be to have this Board meet periodically and to thoroughly look into the merits of any inventions which may be submitted to the Government by the many inventors throughout the country.

It is undoubtedly true that in the past many worth-while inventions have been either smothered, so to speak, forever, or else they have been taken over by foreign governments, owing to inadequate facilities for examining such inventions.

The idea to be followed will be to have this Advisory Board of famous engineers and scientists so balanced as regards its personnel that all distinct branches of applied science to-day will be represented by undoubted leaders in those particular fields. Thus, any inventions submitted to this Board will naturally be given the best and proper attention possible. Proper laboratory and field arrangements are to be made for testing out such inventions in a practical way.

The English, and particularly the German, governments have long recognized that scientific men can help very materially in developing proper equipment and machinery for the defense of the nation. Such farsightedness will always repay a thousandfold the development expenses incurred, and it is the rankest kind of folly to expect that we or any other nation can even hope to cope with modern war problems with such a proportionately small army and navy as we possess. To offset this is the task of the new Board of Scientists.

SELENIUM CELLS AND RADIO TORPEDOES.

The problem of radio selectivity may be cast aside as one of secondary importance, and the real problem of keeping the enemy from tampering with the torpedo by means of their own wireless transmitter solved by the use of apparatus which will make them their own executioners, says B. F. Miessner in *Purdue Engineering Review*, in discussing radio-controlled mechanisms, etc.

In 1912, while associated with John Hays Hammond, Jr., he developed an apparatus which was called "An Orientation Mechanism." The principle involved in this machine has been applied to torpedo control with this same idea of making it hazardous for the enemy to attempt interference. This orientation mechanism, which has also been popularly called the "Electric Dog" (see June, 1915, issue of this magazine), in its present form consists of a rectangular box about 3 feet long 1½ feet wide and 1 foot high. This box contains all the instruments and mechanism, and is mounted on three wheels, two of which are geared to a driving motor (see diagram), and the third, on the rear end, is so mounted that its bearings can be turned by solenoid electromagnets in a horizontal plane. Two 5-inch condensing lenses on the forward end appear very much like large eyes.

If a portable electric light, such as a hand flashlight, be turned on in front of the machine it will immediately begin to move toward the light and, moreover, will follow that light all around the room in many complex manoeuvres at a speed of about 3 feet per second. The smallest circle in which it will turn is about 10 feet diameter; this is due to the limiting motion of the steering wheel.

Upon shading or switching off the light the dog can be stopped immediately, but it will resume its course behind the moving light so long as the light reaches the condensing lenses in *sufficient intensity*. Indeed, it is more faithful in this respect than the proverbial ass behind the bucket of oats. To the uninitiated the performance of the psuedo dog is very uncanny indeed.

The explanation is very similar to that given by Jaques Loeb, the biologist, of reasons responsible for the flight of moths into a flame. According to Mr. Loeb's conclusion, which is based on his extensive researches, the moth possesses two minute cells, one on each side of the body. These cells are sensitive to light, and when one alone is illuminated a sensation similar to our sensation of pain is experienced by the moth; when both are equally illuminated no unpleasant sensation is felt. The insect threfore keeps its body in such a position, by some manner of reflex action, as will insure no pains, and in this position the forward flying motion will carry it directly toward the source of light.

The *orientation mechanism* here mentioned possesses two selenium cells corresponding to the two light sensitive organs of the moth, which when influenced by light effect the control of sensitive relays instead of controlling nervous apparatus for pain production, as is done in the moth. The

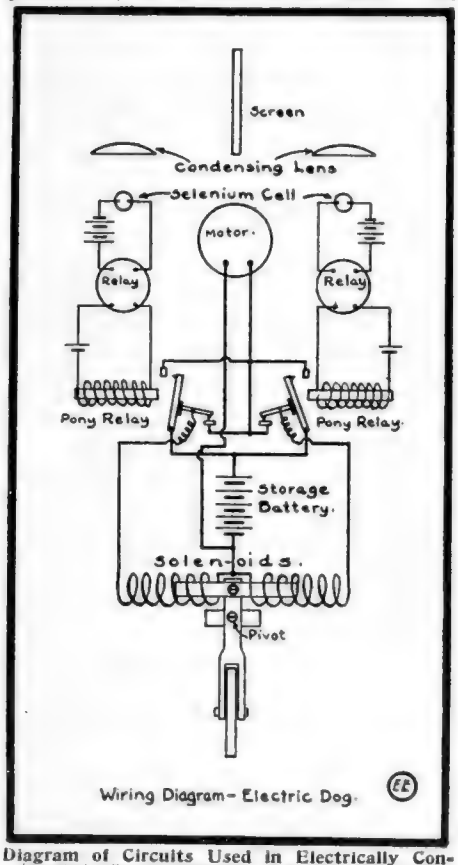


Diagram of Circuits Used in Electrically Controlled "Dog" Utilizing a Beam of Light and Two Selenium Cells.

two relays (500 to 1,000-ohm polarized preferred) controlled by the selenium cells in turn control electro-magnetic switches, which effect the following operations: When one cell or both are illuminated the current is switched on to the driving motor; when one cell alone is illuminated an electro-magnet is energized and effects the turning of the rear steering wheel. The resultant turning of the machine will be such as to bring the shaded cell into the light. As soon and as long as both cells are equally illuminated in sufficient intensity, the machine moves in a straight line toward the light source. By throwing a switch, which reverses the driving motors connecting, the machine can be made to back away from the light in a most surprising manner. When the intensity of the illumination is so decreased by the increasing distance from the light source that the resistances of the cells approach their dark resistances, the sensitive relays break their respective circuits and the machine stops.

The principle of this orientation mechanism has been applied to the "Hammond Dirigible Torpedo" for demonstrating what is known as *attraction by interference*. That is, if the enemy tries to interfere with the guiding station's control the torpedo will be attracted to him. The torpedo is fitted with apparatus similar to that of the "electric dog," so that if the enemy turns his searchlight on it, it will immediately be guided toward that enemy automatically.

In order that the searchlight used by the control operator may not have this same effect, use is made of a gyroscope to keep the turntable upon which the cells are mounted in a fixed position relative to the earth. In this way, no matter how much the torpedo turns, or in what direction it is traveling, the selenium cells will always face from the shore toward the attacking battleship in the open sea.

By means of two directive antennae, instead of two selenium cells, the same principle may be applied for attraction by interference when *Hertzian* instead of light waves are used. Sound waves might also be utilized in a similar manner, so the sound reaching the torpedo (which would be equipped with two submerged microphones, made sensitive and directive by megaphone attachments) from the pounding of the battleship's engines and other machinery would effect its attraction in a way analogous to the attraction of a source of light for the orientation mechanism. It is just possible, too, that similar apparatus could be used for the detection of submarines or for defense against them.

TWO GREAT INVENTORS WHOSE FORESIGHT DID NOT EQUAL THEIR INGENIOUS ABILITY.

Not infrequently great inventors do not comprehend the significance of the thing they have produced. An interesting anecdote of two famous men of science whose foresight did not equal their inventive ability appears in *Les Inventions Illustrées*.

When Hertz first began to obtain satisfactory results from his now famous researches into the possibility of transmitting electric waves certain men of science suggested that some day similar vibrations might serve to transmit messages through space. Hertz laughed at the hypothesis and assured all comers that his experiments were for laboratories only. Now, after a few short years, it is hard to find a single issue of a daily paper that does not record some noteworthy example of the use of wireless telegraphy.

Likewise with Levassor, the great engineer, who sketched the automobile with such skill that his first design has not been materially changed to this day. After Levassor accomplished his historic trip from Paris to Bordeaux and return at the dizzy speed of about 15 miles an hour his admirers gave him a banquet. During the toasts one of them stirred by the spirit of the occasion, arose and enthusiastically called on the assembly to drink to the approaching day when carriages should travel at the speed of 60 miles an hour. Levassor turned to his nearest neighbor and asked in a quick undertone, "Why is it that after every banquet some people feel called on to make fools of themselves?"

LAKE HOPATCONG, N. J., HAS RADIO CONTROLLED BOAT.

A motor boat on Lake Hopatcong, N. J., is operated by wireless from a tower at Woodport. It has a mast at each end, with five projections on one and seven on the other. James Wilson, New York, owns it.

How Telephone Transmitters and Receivers are Made

(Concluded)

ILLUSTRATION 6 and 7 portray the make-up and assembled views of the watch-case receiver. The reason why the longer style of receiver is employed for practically all commercial "Bell" equipment is because this design permits of placing longer and very powerful permanent steel magnets in it. The watch-case receiver is used extensively for telephone work also, especially as an auxiliary receiver, so that the person using a long-distance line may have a receiver at each ear, thus gaining the utmost efficiency acoustically by acting on both ears simultaneously.

For wireless telegraph and telephone work the watch-case receiver is the only practical form available so far, as the operator has to have a pair of receivers strapped on his head for hours at a stretch. The present wireless receivers are highly perfected indeed and, as their manufacture covers all the more important steps of this specialized industry in general, this discourse will conclude with their more important construction details.

First let us look at Figs. 4 and 6, where the component parts of the wonderful telephone reproducer of speech are depicted. Here we see the cap 1, made of hard rubber or composition. This threads onto the end of the receiver shell 5, and between them they clamp by its circular edge an iron diaphragm 2, about 2 inches in diameter. This magnetic (iron) diaphragm is acted upon constantly by a strong magnetic field created by a hard, magnetized steel member 4, of U section for long-type receivers and of circular or ring section for watch-case receivers, as Fig. 6 shows.

Fig. 7. Ultra-Sensitive Telephone Receivers Designed for Wireless Work.

On the permanent magnet 4 is mounted a pair (sometimes only one) of soft iron pole pieces on which are wound many turns of fine insulated copper magnet wire. For all regular telephone work the coils have a total resistance of 75 to 80 ohms. Wireless receivers have from 1,000 to 3,000 ohms resistance each usually, as the current used is very minute, or a few millionths of an ampere.

Each receiver shell, of course, carries suitable binding-post terminals 7, or some receivers have no posts. An insulating disc 6 (Fig. 4) is sometimes secured to the end of the shell 5 to carry the posts 7.

What we read previously regarding the scientific research on diaphragms for the transmitters holds good here also; only in that here the diaphragm is necessarily to be magnetic in character or at least must have an iron center. The design of the caps has been very thoroughly gone into, regarding their acoustic properties, etc.

The following details of manufacture applying to the wireless receivers will give a good idea as to the amount of fine work involved in their successful production.

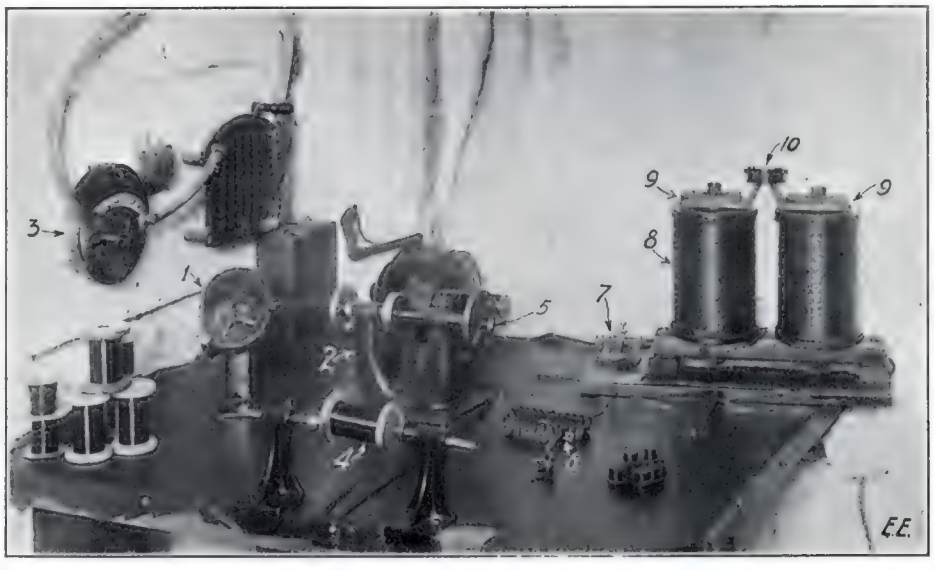


Fig. 8. Showing a Corner of the Winding and Magnetizing Shop Where Wireless Receivers Are Built.

The photograph (Fig. 8) shows one of the winding and magnetizing tables used in making the *"Electro"* radio receivers.

Materials Used.

The vital items in any receiver are the following: The permanent magnets, the wire used, the pole pieces, the diaphragms.

The permanent magnets in all wireless receivers are made of the highest grade tungsten steel, manufactured in Sweden. After the magnets are blanked or punched out to shape they are hardened glass hard. There is a big waste in this process, as many pieces warp so badly that they cannot be used. Each blank is then tested for hardness by an inspector and no blank that can be scratched by a file is acceptable. Such blanks are scrapped. Consider that this steel costs from 35 to 40 cents per pound before blanking, when domestic steel can be had for from 16 to 20 cents. Then consider that but 70 per cent. of the blanks pass inspection, and that a pound of the steel does not furnish many blanks indeed.

The pole pieces, which perform a very important function, must be of the softest possible iron. Nothing but the best grade of inspected Swedish iron will do, and not all grades are satisfactory.

The wire used in the receivers is imported enamel wire. It is No. 43 B. & S.—a wire so fine that the eye hardly perceives it. Only a specially trained operator can wind it on account of its great fragility.

There is at present no suitable No. 43 enamel wire made in the United States. None seem to have the high insulating values of the European wire, and the domestic wire of this size, furthermore, tears so easily that it cannot be used in a high-speed winding machine.

There have been some controversies as to the use of enamel wire for wireless receivers in the past. Exhaustive comparative tests have shown that enamel wire is infinitely more efficient. We cannot here go into a lengthy technical discussion as to the great merits of enamel wire; suffice it to cite the following: No one will deny that the more (ampere) turns one can wind on a given core, the better the electro-magnetic results, always bearing in mind, of course, that the nearer the winding to the core the more efficient the electro-magnet will be. Thus, previously these receiver spools were wound with 5,700 turns of No. 44 B. & S. silk wire. Now there are used 6,600 turns of No. 43 B. & S. wire—a heavier wire (carrying more current) and winding almost 1,000 more turns wire in the same space, without increasing the distance between the pole piece and the last layer. This example makes it clear why the present highly perfected receivers are so infinitely more sensitive than they were previously.

"Resistance" is a very empty quotation in connection with a radio receiver. Thus, if we could use German silver wire in receivers it would be possible to save a large amount of money in manufacture. Of course, it is absolutely impossible to use this wire, for the reason that resistance wire "chokes" almost all signals. Not even satisfied to use good copper wire, the specifications for enamel wire invariably call for the highest grade electrolytic copper. This costs quite a little more, but it is possible to get from 1 per cent. to 3 per cent. better conductivity—an appreciable amount when we wind over 6,000 turns of wire on a bobbin.

The diaphragm is one of the least understood parts in telephone engineering to-day. The highest authorities have written books and pamphlets about it, there have been endless discussions, and it is quite safe to say that some millions of experiments have been made, in order to find out just how a diaphragm works. We only know this: We know mighty little as yet. In H.

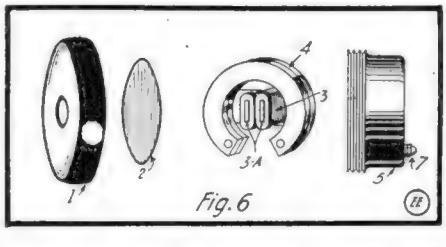


Fig. 6. Details of the "Watch-Case" Telephone Receiver.

Gernsback's laboratory, at New York City, can be found several hundred diaphragms made of strange materials, as well as in strange shapes. There are diaphragms of pure nickel, some of the new magnetic al-

loys, some made of the latest silicon-transformer iron, some with curious holes and curious laminations, some made of iron wires, some made of mica with iron center, etc., etc. Even when blanked out from the best calendered sheets, 25 per cent. of the diaphragms have to be scrapped. They do not all come absolutely flat. Some will be dished, some warped. Neither will the most careful inspection always reveal small defects; for when the receivers are finally assembled some will give a noise instead of a clear note. Thus it will be seen that the insignificant diaphragm is a very important as well as costly item.

Winding.

The most important as well as interesting operation is the winding of the very small telephone bobbin. A specially constructed machine does this work. Fig. 8 shows it; 1 is the automatic revolution counter, which counts the turns of wire on each bobbin. Each style receiver bobbin is wound to a certain number of turns. Thus each bobbin of a 1,500-ohm receiver is wound to 6,600 turns, while each bobbin of a 1,000-ohm receiver is wound to 5,500 turns, and so on. When the hand of the dial arrives at the, say, 6,600th turn, a bell rings and the operator stops. As the wire is remarkably uniform, the resistance of each bobbin will not vary for more than 1 to 2 ohms. The winding machine proper 2 is operated by an electric motor. The control of the machine is foot-operated. The speed regulator is shown at 3. The fine wire supply-spool is shown at 4, while the bobbin 5, in process of winding, is held in an ingenious chuck. Completed bobbins are shown at 6.

Only a thoroughly experienced female operator can wind the No. 43 wire at a high speed without having several breaks in each bobbin. It is a very hard task at best, very trying as well as tiring. It is also necessary to operate the winder at a high rate of speed, as else the wire does not "pack" tight enough. Thus an inexperienced operator can only get about 75 per cent. of the required wire on its bobbin. Naturally the machine must run very steady and smooth to obtain the correct results. After the bobbins are wound and equipped with lead wires they are tested by means of an ohm-meter. Those that test either too high or too low are discarded. The bobbins next go to the female assemblers who make up the complete receiver. Before they leave the assemblers' hands, however, the receivers undergo various tests and several inspections.

Calibrating.

The receivers are now placed in trays, each tray containing some 60 receivers. They are then taken to the calibrating machine, where the pole pieces, as well as the receiver shell edge, are machined down within 1/5000 of an inch accuracy. For it is of the utmost importance that the pole pieces are of quite equal height, and that the edge of the casing be a certain few thousandths of an inch higher than the pole pieces. Also the rim of the casing must be absolutely smooth and even as well as absolutely parallel with the pole pieces. This calibrating is a very tedious operation and can only be performed by skilled mechanics having long experience. This calibration process takes from eight to 10 minutes for each receiver. After the receivers have been calibrated they are inspected by means of a micrometric appliance to make sure that the pole pieces come to 1/5000 of an inch parallel with the rim. If the variation is too great the receiver must be recalibrated.

Magnetizing.

After calibrating, the receiver is ready to receive its magnetic baptism. Fig. 8, at the right, shows the apparatus that does it. The extremely powerful electro-magnets connect without any resistance to the 220-volt power current. A large manipulating key 7 serves to close and break the current, which circulates around the spools 8. When energized, this electro-magnet is capable of lifting over 500 pounds. Only a very powerful electro-magnet produces satisfactory receivers.

On top of the spools we see the adjustable pole pieces 9 9. On top of these the telephone receiver 10 is now placed by the magnetizing operator. The current is then turned on and broken a number of times, in a peculiar manner, while the receiver undergoes several mechanical treatments to age it. After a few minutes the receiver is completely magnetized, and is now tested once more, this time to ascertain if it is magnetically strong enough. The receiver, if passed by the inspection, now goes back to the assembling department. Here it is cleaned thoroughly and polished. Certain parts inside are then enameled and lacquered. After drying, the diaphragm, as well as the hard-rubber cap, is put in position and the receiver is finished. The receivers are then assembled on the head band, the cords are put on and the head set is ready for the final tests. The first test is for resistance. If this has been found correct the completed receivers are sent to the wireless room, where, by means of several ingenious instruments, the phones undergo several tests for sensitivity. Those not checking up with the standard are returned to the factory.

The final, supreme test is the wireless test in actually receiving signals. Phones not sounding clear and sharp are returned to the factory to be made over.

This completes the receivers. Each set is now tagged and signed by the tester, and the phones are then ready for packing.

The "Bell" receivers, etc., go through the different operations just mentioned, and in many cases they are tried out on *"artificial lines"* for talking power, as the inductance, capacity and resistance of the line all tend to affect the performance of the receiver as well as the transmitter. Standard transmitters are tested usually on 28 to 30-mile circuits in the testing laboratory. The phonograph has not substituted the human voice for these tests, strange as it may seem.

Voting Results.

It gives us pleasure to publish herewith the final results of the voting contest between the readers of the *Electrical Experimenter.*

In the June issue we printed a Voting Blank, asking our readers to fill it out by giving their preference of the various departments. The idea proved a huge success.

It was astonishing as well as gratifying to the publishers how much interest was evidenced in this contest. A surprising and quite unexpected feature was that 68 per cent. of the voters thought so much of their magazine that they did not want to cut out the voting blank. Instead, they copied it on a piece of paper! Frankly, we had never thought of that!

Up to July 24, 6,286 votes had been received, and they are still coming from all parts of the globe—China and Brazil included!

Six thousand one hundred and fourteen were satisfied with the magazine as a whole; 212 made valuable suggestions—some of them very valuable; 172 criticised us—some harsh, some mild—on various subjects. Some of these wanted nothing but wireless, some nothing but "How-to-Make-It," and so on.

On the whole, every voter seemed well satisfied. The following table accurately shows the tabulated preferences of 6,286 readers. It requires no comment, except that we will be guided by the wishes of our readers and we will give them exactly what they ask for, in the proper proportions:

"How-to-Make-It" Dept.	1
"Wireless" Dept.	2
The Constructor	3
General Electrical Articles	4
"Münchhausen"	5
Electrical Experiments	6
Among the Amateurs	7
Question Box	8
Magazine Review	9
Latest Patents	10

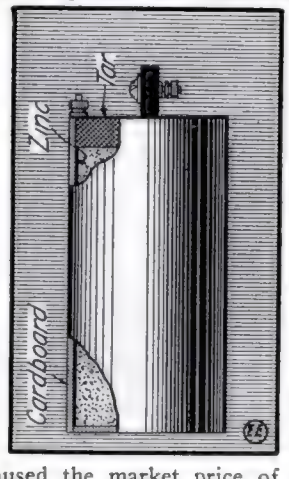
The average age of our voters proved to be 18. The extremes were as follows:

Of the 6,286, 12 were 11 years old, and 16 were 48 years old.

After passing the 20-year stage we found 96 to be 21 years old and 64 were 22 as well as 29 years old.

WAR AFFECTS CHANGE IN DRY CELLS.

Due to the present war conditions, which



have caused the market price of zinc to "sky-rocket" to dizzy heights, or in fact to about three times what it originally cost before the war, dry cell manufacturers have evolved a new scheme for cutting down the cost of the zinc outer shell electrode of such batteries.

As the sketch herewith shows, the zinc now is in the form of a very thin shell, only extending as high as the active element in the battery. At the bottom of the cell it simply extends to the base of the compound element and no zinc disc is used as a bottom, as formerly. Also, to protect this thin zinc shell, a heavy cardboard covering suitably impregnated to withstand the action of the chemicals is placed over the entire battery.

ABOUT RADIO TORPEDOES.

Several well-known electricians have expressed the opinion that the new wireless torpedo will be ineffective, owing to the liability of its control being lost, through interference by waves from other wireless sending appliances. This objection was raised when the idea was first advanced by Nikola Tesla, but it is claimed by the inventor of the Hammond system of wireless direction and operation that this liability has been eliminated. In a long series of tests made by the operators of the wireless outfit on the United States steamer "Dolphin," said to contain the strongest wireless sending plant in the United States, interference was shown to be impossible until within 250 feet of the torpedo.

How to Construct a Galvanometer.

A USEFUL galvanometer is easily made up as described below. The woodwork used presents no difficulty. Any well-seasoned wood can be used—in the present instance some odd pieces of mahogany came in very well. After the frame has been made, wrap several layers

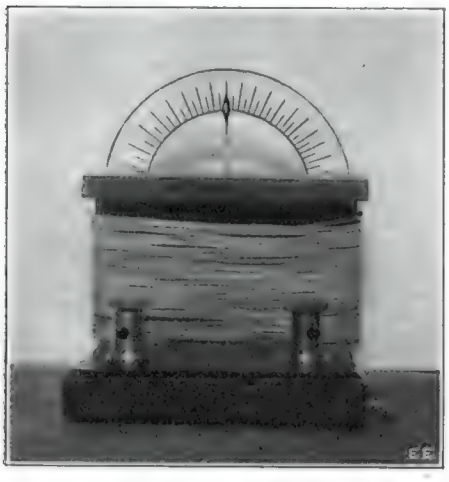


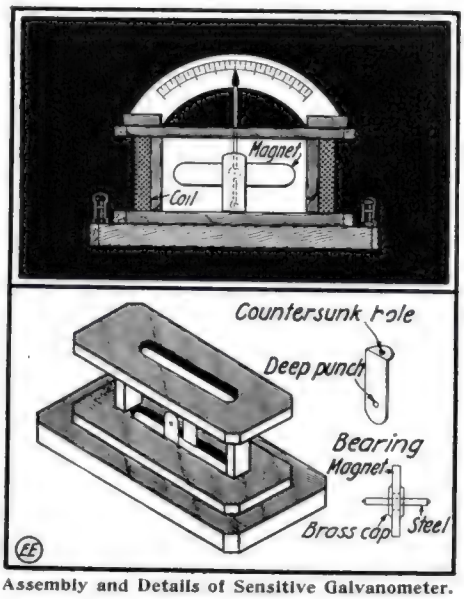
Photo of Complete Galvanometer. (Four Posts Being Used; Only Two Shown.)

of wire around the bobbin itself. The wood can be finished to the fancy of the maker. A good rubbing with linseed oil makes a quick and lasting finish and safeguards against dampness.

There are two magnetic windings. The first is a high resistance winding of two, even, close layers of No. 30 D.C.C., although a little finer would be even better. The beginning and finishing ends are led through two small holes at one end of the bottom flange. This winding is then given a good coat of shellac varnish, and a strip of brown paper is then laid over it which is also shellacked. The outer winding is two close layers of No. 20 D.C.C., also well shellacked, forming the low resistance coil. A finishing cover of varnished paper can be laid over this, if thought necessary. The two ends of this winding are taken through two holes in the other end of the lower flange.

The magnet is a strip of steel cut from a small hack-saw blade. It may be annealed in a Bunsen gas flame to be soft enough to cut and drill. Round the ends nicely, and exactly in the center drill a 3/16-inch round hole. Now take a short piece of ¼-inch round brass. Shoulder (in a lathe) one end down to 3/16 of an inch for about ⅛ of an inch; pass this small end through the hole and rivet it over. Cut off the remaining ¼-inch end, leaving 1/16 of an inch projecting from the steel, and you will have a nice boss in which to mount the spindle. Now place the steel in a bright, clear fire, and as soon as it has reached a dull red heat lift it out and at once drop it into a basin of cold water. It will now be very hard and brittle. Next carefully clean it up with fine emery cloth and drill a 1/16-inch hole exactly in the center of the brass boss. To make the spindle get a knitting needle (steel, of course) that is just a shade too large for the hole. Very carefully force it through with gentle blows. File down the ends of the spindle until they are brought to points, which must be central and finish quite smooth. The final smoothing can be done with a narrow strip of the finest emery cloth glued on a slip of wood. Do not make the points with too long a taper. When finished, the over-all length of the spindle should just exceed one-half inch. Now you may magnetize the steel blade as strongly as you can—either by stroking it many times with one pole of a strong magnet, or by passing a strong current of electricity for a minute or two through a coil of wire wound around it.

The pointer and balancing counterpoise can now be attached. They are made from a piece of the No. 20 D.C.C. wire with the insulation removed, and are fastened to the brass boss with just a drop of solder. Just a word of warning here: Do not make the soldering too long a process, or the heat of the "iron" will weaken your magnet. To avoid this you might magnetize the steel after the soldering is done, though it is not then quite so convenient. The lower end of the counterpoise is formed of a small loop of the wire filled with a little blob of solder. By holding the ends of the spindle lightly between the finger and the thumb, a little manipulation



Assembly and Details of Sensitive Galvanometer.

of the counterpoise will cause the magnet to rest horizontally with the pointer vertical.

THE CONSTRUCTION OF AN EXPERIMENTAL ARC LAMP.

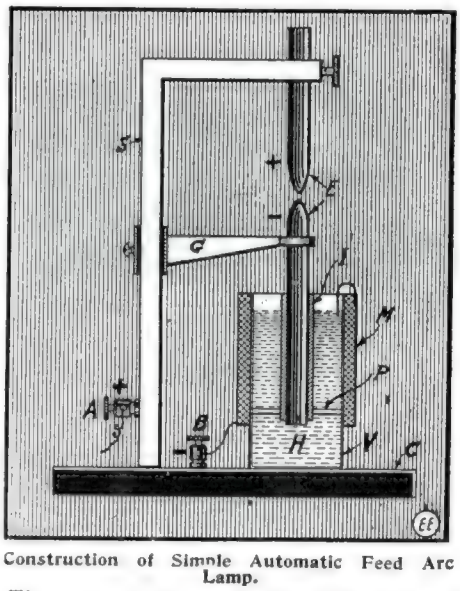
An arc lamp, whereby the essential features of this illuminating device can be demonstrated, can easily be made as shown and described in this article. While the lamp here shown, does not have the refined feeding mechanism with which commercial arc lamps are provided it will operate under the conditions specified and will show how electrical energy can be converted into light.

The electrodes *E* are lengths of electric light carbons. The upper carbon is supported by an upright *S*, which should be of metal, inasmuch as it comprises part of the electrical circuit. In operation the current should enter the binding post *A* and leave at the binding post *B*. The base *C* is a block of wood. On this base is carried a glass or metallic vessel *V*. An iron sleeve *I* should be fitted over the lower end of the negative electrode. This sleeve should fit snugly so that the friction between it and the electrode will hold it in place. This sleeve has two functions. The first is to provide good electrical contact between the negative electrode and the mercury in which its lower end floats, the second is to provide a supporting medium for the guide pins *P* which will be described later.

The metal guide *G* which holds the negative carbon in line with the positive carbon is supported on but insulated from *S*. Three pins *P* screwed into the lower end of the sleeve *I* guide the lower end of the negative electrode.

The solenoid *M* consisting of about 100 turns of No. 14 gauge insulated copper wire is wound around the upper part of *V*. One of the terminal wires of this solenoid connects to the binding post *B*, while the other dips into the mercury *H* with which the vessel is filled.

Now we will trace the electrical circuit through the lamp. The current enters at *A*, passes through the metal stand *C* to the positive electrode. Then it arcs to the negative electrode and passes down it and into the mercury. The path is then through the coil or solenoid *M* and to the negative binding post *B*. With this, as with every other arc lamp, a resistor of a few ohms resistance and of sufficient capacity to carry the current of the lamp, must be connected in series with the lamp. Every electric arc must have, for reasons which cannot be discussed here, in series with it, either a reactance or a resistance as "ballast." The lamp here shown when connected as described will operate on a 110-volt circuit. The principle of operation is this: When the switch is closed and current is permitted to pass through the lamp, the negative electrode which ordinarily is forced upward by the pressure of the mercury into contact with the positive electrode, is drawn downward by the electromagnetic action of the solenoid *M*. That is, when no current is passing through the solenoid the lower end of the carbon encased in its iron sleeve floats in the mercury just as a cork floats on water.



Construction of Simple Automatic Feed Arc Lamp.

The mercury buoys the negative carbon up against the positive carbon. As the lamp burns the electrodes are consumed, which increases the distance between them and tends to increase the resistance of the circuit. The current through the solenoid

M is thereby decreased and its electro-magnetic effect proportionately reduced, hence the negative carbon is permitted to rise. It is evident therefore that this lamp feeds itself automatically.

It is not essential that carbon be used for the electrodes of this lamp. Metallic electrodes can be used instead. While the metallic electrodes will burn away much more rapidly than those of carbon, they will provide light of certain qualities that may be desired to satisfy certain specific conditions. For example, with the positive electrode of steel and the negative of carbon a light which is very rich in actinic rays is produced. This kind of light has the property of acting very rapidly on photographic plates. Actinic rays of light are sometimes called ultra-violet rays. Where experiments are being made with ultra-violet rays, the eyes must be shielded from their effects by *clear glass spectacles.* Otherwise inflammation of the eyes and other ailments may be produced. Clear glass has the property of sifting out ultra-violet rays—they cannot pass through it. Contributed by

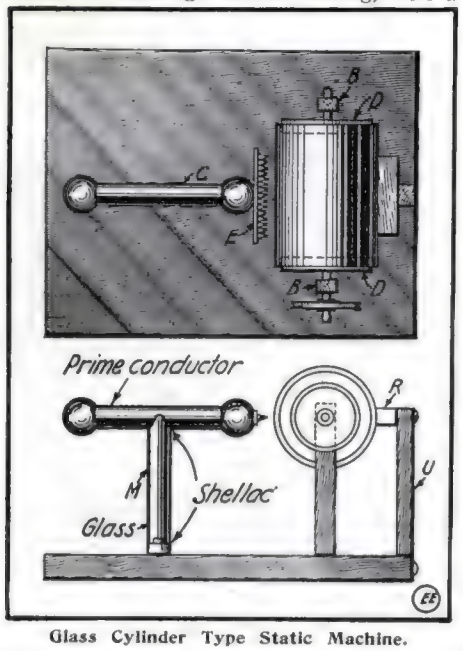
J. A. GILMAN.

THE CONSTRUCTION OF A FRICTIONAL ELECTRIC MACHINE.

A FRICTIONAL or static electrical machine can be made as shown in figure. With this device many interesting experiments in static electricity can be performed.

In any frictional machine it is necessary that some insulating material be arranged to rub against a dissimilar material. Theoretically, the friction or contact between any two dissimilar materials will develop frictional electricity, but it has been found in practise that the friction of glass against a certain amalgam, which will be described, gives the best results. The apparatus shown herewith is an arrangement whereby a glass cylinder is made to rub on an amalgam.

The glass cylinder can be about 4 inches outside diameter and 6 inches long. This cylinder can be cut from a jar or bottle. Or else the jar or bottle can be mounted between two bearings without cutting, after a



Glass Cylinder Type Static Machine.

manner that will immediately suggest itself to the experimenter. If a glass cylinder is used, two disks of dry wood *D* are fitted into its ends and cemented there with shellac. The axle is a metallic rod about 8 inches long and ¼ inch in diameter. This axle should be cemented into the end pieces *D* with shellac. The bearing blocks *B* should be of dry wood about 6 inches high, 1 inch wide and ⅞ inch thick. Each is fastened in place on the base block by a couple of flathead screws, turning up into them from the bottom of the block. A ¼ inch hole is bored in the upper end to accommodate the axle.

If the cylinder is to be turned by hand a wooden crank is arranged at one end of it, but if an electric motor is available for driving it a wooden pulley is mounted on and cemented to one of the axles. All of the wooden parts of the machine should be thoroughly dried and varnished with two coats of shellac. The cushion *R* is a block of wood about 4 inches long and ⅞ inch wide. It is wrapped with five servings of flannel and then covered with two additional servings of silk cloth. This cushion is secured after the cloth has been wrapped around it to the end of a wooden upright *U* with one or two wood screws. Before the cloth is wrapped on the cushion the edge of the cushion block that is to bear against the glass cylinder should be rounded out somewhat so that it will approximately have the curvature of the cylinder. After the cushion block and upright are in place the cloth on the block should bear firmly against the cylinder.

In operation the cushion should be well coated with an amalgam compound as follows: Melt together two parts of zinc and one of tin. While these metals are fluid add to them six parts of mercury. Now pour this alloy into a wooden box and agitate the box until the alloy is cool. Before applying the amalgam to the cushion it should be mixed with a small amount of lard so that it will stick to the cloth.

The prime conductor *C* is made of brass tubing. A piece of tubing having an outside diameter of 1 inch and a length of about 4½ inches will serve the purpose. At each end of this tube a brass ball about 1½ inches in diameter is soldered. The ball should be smooth. Such balls can be obtained from window curtain fittings. The comb *E* is made by inserting in a strip of sheet brass about ⅜ inch wide and 4 inches long a number of brass tacks or brads. These points should not be more than 3/16 inch or ¼ inch apart. The head of each point should be soldered to the comb strip. This comb strip is now soldered to the prime conductor *C* as shown.

The prime conductor support *M* is shown as a piece of glass tubing, but a stick of sealing wax can be used. Glass is the better material. At its lower end *M* fits over and is shellacked to a wooden boss, which is held to the base with a wood screw. At its upper end the prime conductor *C* is cemented to *M* with sealing wax or shellac. After the prime conductor is fixed in position it should be of such a height and so arranged that the points of the comb will be no further than 1/16 inch from the glass cylinder. Furthermore, the points should be on a level with the center line of axis of the cylinder.

In using this frictional machine it should be carefully cleaned with a dry rag or a camel's hair brush and should be warmed before a fire to drive off any surplus

(*Continued on page* 208.)

HOW TO MAKE A "BUG" KEY.

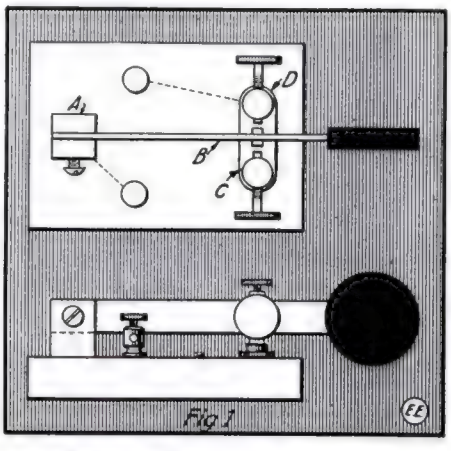
"Bug" is the name given double-contact telegraph keys that use a horizontal instead of a vertical motion. Although these do not possess all the advantages of the automatic keys, they are far superior to the ordinary key and therefore worthy of a place in every radio or telegraph station.

Ease of construction is one of their advantages, and this will be apparent by a glance at the drawing. I have given all the dimensions necessary, but a few words will not be out of place.

A piece of hard rubber is used for the base, but fiber, marble or hardwood may be used with good results. The holes are drilled with a No. 19 drill, or large enough to pass the 8/32 screws as used to hold the various parts to the base. The edges of the base may be beveled off with a file.

The standard A to hold the spring is made from a piece of ½-inch square brass rod ⅝ inch long. This has a hack-saw slot ⅜ inch deep cut in it and two holes drilled and tapped as shown.

The lever B, of phosphor bronze or spring brass, is 3⅜ inches over all without the knob attached, ⅝ inch wide and 1/16 inch thick. This will be found to have about the proper tension, and no adjustments will be found necessary. The lever has a piece of silver wire riveted into a hole in the

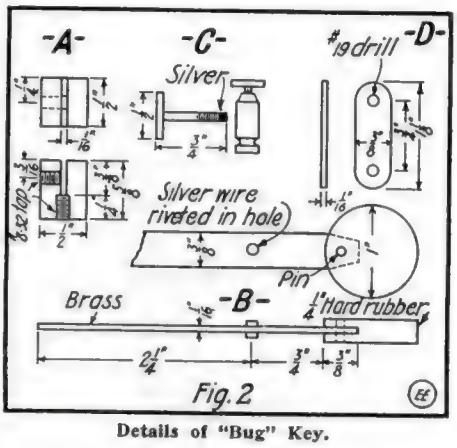


Making a "Bug" Telegraph Key.

position shown in Fig. 2, and is fastened to the knob by inserting one end into a slot cut into the knob and held there by means of a small pin driven through, as is also shown.

Four common binding posts, the two contacts C C (Fig. 2) and the small brass strap D complete the list. The contact pieces C C have short ends of stout silver wire soldered onto their heads.

Assemble these parts as per drawing and you will have one of the handiest instruments you could own. The knob is held lightly between the thumb and forefinger and moved from side to side, remaining in each position long enough to give the necessary dot or dash.



Details of "Bug" Key.

If the base is polished and the brass-work nickeled, the appearance of the "bug" will be greatly improved. Contributed by

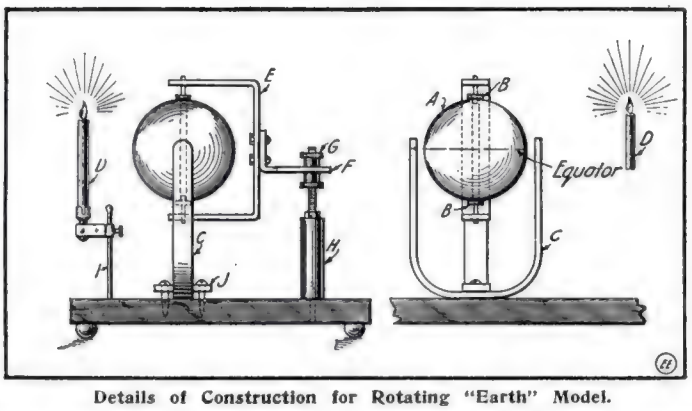
THOMAS W. BENSON.

NOVEL EARTH GLOBE WHICH ROTATES ELECTRICALLY.

A striking model of a revolving earth globe, on which is painted a map of the earth in the regular way, has recently been brought out. This model has a sphere A, delicately mounted between the poles of a strong permanent steel magnet C, as the illustration shows. The sphere measures 2½ inches in diameter, but this may be varied somewhat in case the experimenter intends building one.

New Form of Electrically Operated Rotating "Earth" Model.

The peculiar part about the sphere is that the upper half of same is made of very thin copper, which can be provided for by using a hardwood ball of the proper size and hammering the copper over same with a wooden hammer in the same way that coppersmiths do such work. Attached by glue or otherwise to this upper copper hemisphere is a lower hemisphere made of Bristol board or paper, etc. Suitable supporting means is suggested in the sketch, E and F being made from brass as well as the rest of the parts, excepting the steel magnet C. This magnet may be secured to the base by a piece of brass or wood J, together with a few wood screws. A brass rod I serves to support a candle holder and candle D, as observed.



Details of Construction for Rotating "Earth" Model.

This model is found to operate best when the source of light or candle flame, etc., strikes the sphere midway between the equator and the upper pole of the sphere. *Even the light from a match will cause the sphere to rotate.* In some cases a slight push may be necessary to start it, but invariably it does so automatically. The vertical position of the sphere is important and it should be tried out at different heights with respect to the magnet poles.

Why does the ball turn? is the question often asked. No one knows precisely. There are many theories or "explanations." Among them is that of the German scientist, Albert Lotz. He suggests that magnetic forces, in conjunction with the sun's heat, are constantly operating like spiral tides or gently wheeling currents to turn our globe around. This little revolving earth model is intended to illustrate this theory. Whether the theory be true or false, it is interesting to see it given such clear and attractive expression.

A DRY STORAGE BATTERY.

The average cyclist seems hardly to appreciate the value of electric lighting for his bicycle; he is accustomed to using the old form of oil or gas lamps and only recently several manufacturers have brought to the attention of the public electric dry battery bicycle lamps.

The main disadvantage is in the dry cells used. These batteries are not intended for continuous use, but for intermittent service, and the question then arises, "Why may not a storage battery be used?" This is readily answered in the following: The regular storage battery, as made to-day, contains a very corrosive acid, known as sulphuric acid; the container of same must be kept open by means of a vent during the working of the cell, as gases are constantly being given off. For this reason they cannot be readily used on bicycles, as any vibrations would cause the acid to spill, resulting in serious damages.

The writer, having experienced the above-mentioned difficulties, gives herewith two simple methods for converting a liquid storage battery into a dry type, which may be used in connection with a vehicle or for other portable work, with success. The first method consists of the following:

Make a paste mixture of some ordinary sawdust, immersed for 20 hours in a zinc chloride solution, which can be obtained from any chemical house at 10 cents a pound. After the sawdust has been saturated in the chloride solution, it should then be allowed to dry for about 12 hours. Then wash the sawdust in several hot waters to thoroughly clean it, then dry again. Having done this, fill the storage battery with this mixture and add the sulphuric acid, having the same specific gravity as if the battery were ordinarily used. It should then be charged as usual, and it will be found that by shaking or inverting the battery, the solution will not spill; the sawdust mixture has absorbed the acid and at the same time is pressing against the plates, giving them a live acid surface.

The second method: Fill the cell full with ordinary glass wool, and add the acid until the wool is completely saturated. This glass wool may be procured from glass blowers.

It will be found that the above-mentioned methods of converting a wet storage

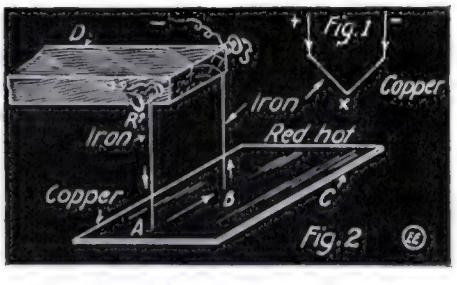
(*Continued on page* 208.)

DEMONSTRATING THE PELTIER CURRENT EFFECT.

The materials required for this experiment are a few good primary cells—or, better, a storage cell—a flat piece of copper sheet, two binding posts, a few steel needles and a small piece of wood. Thus equipped we are about to demonstrate the "Peltier effect."

First let us state what that effect is, says R. E. N. in *Model Engineer*. Referring to Fig. 1 if we pass a current through iron and copper wires twisted together at X to form a series circuit the junction will be *heated* when current passes from iron to copper and *cooled* when current flows in the opposite direction. This effect is not the ordinary heating effect of an electric current. As the temperature increases the Peltier effect decreases till it becomes zero at 280° C. (535° F.); at higher temperatures it reverses, so that heat is developed at the junction when current is sent from copper to iron and cooling is produced when current flows from iron to copper. It must be understood clearly that ohmic resistance at the junction produces the same heating whichever the direction of current flow. The Peltier effect simply adds to or subtracts from this heating.

Suppose now that we fix binding posts R S in one end of a piece of wood D, Fig. 2, and clamp leading-in wires and steel needles in these terminals, so that when the other end of D rests on the table the points A B rest evenly on the sheet of copper C. Current can now be passed from R to S through a steel needle, the copper plate and another steel needle in series. On starting the experiment the needle tips are cool and the junction A (iron to copper) is heated and the junction B (copper to iron) is cooled by the Peltier effect. If, however, 4 or 5 amps. be passed through the circuit the needle tips soon get warm, because their section is very small and their resistance therefore relatively high. The junction A reaches the critical temperature (280° C.) before B; but soon both needle tips are hotter than this, and then the Peltier effect is reversed and the tip B becomes hotter than A, so that ultimately B becomes red hot, while A is still invisible in the dark (the lowest red heat visible in the dark is about 335° C. or 635° F., while "dull red" heat is about 700° C. or 1,290° F.). Owing to the small weight of metal in the needle points, the small amount of heat produced or absorbed by the Peltier effect produces quite considerable temperature rise or fall, and thus permits one tip to become red hot appreciably sooner than the other. If the current be great enough both needle tips will soon be red hot, but that one becomes red first where current leaves the copper plate. If the weight on the two needles is distributed evenly the needle tip A will become red hot first when current is reversed, thus proving that unequal resistance is not the cause of the phenomenon. A fresh pair of needles should be used often. The effect is best seen in a subdued light.



The "Peltier Effect" of Electric Currents.

A GOOD THERMO-ELECTRIC CELL.

The form of thermo-electric cell described below was discovered by J. T. Seebach, a noted German physicist. The cell will prove of interest and moreover is cheaply constructed.

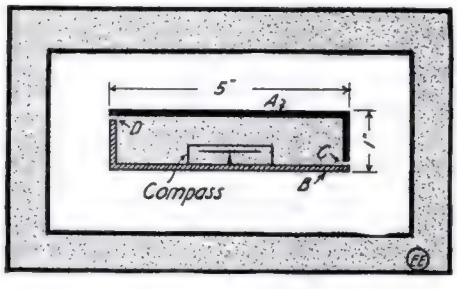
First obtain two metal strips, A and B, about 6 inches long and 1 inch wide; one of German silver and the other of copper. Bend them as shown in figure and then solder the ends together, thus forming a rectangle 5 inches long and 1 inch high.

Now mount a small compass upon the upper side of the lower strip. Place the arrangement upon a non-combustible base and the cell is complete.

To use bring a match or some form of heat near the soldered joints, D or C, and the compass needle will turn slightly, thus proving that an electric current can be generated by heating the union of two dissimilar metals. The wattage of such a cell will be about 1-50 of a watt, and since so much heat is required the cells are not commercially a success, although by using several cells in series-multiple an electric lamp can be lighted.

By soldering two wires to the cell, one to each strip, the following experiments may be tried:

(1) Connect a set of batteries to the two wires and place a drop of water upon the joints. The water will either freeze or boil, and by reversing the battery current the reverse will take place.



Thermo-Electric Cell Which Produces Heat or Cold.

(2) By arranging one corner joint in ice water and the other joint in warm water a current of about 1-12 volt and ¼ ampere may be taken from the two wires, but the wattage obtained in this way will depend upon the following: Surface heated; difference in temperature; metals used; condition of union, etc.

(3) By using antimony and bismuth for the legs of the cell and different patented arrangements experimenters have succeeded in producing a respectable amount of electricity in this way.

Contributed by

WM. R. COTTRELL.

A DRY STORAGE BATTERY.

(*Continued from page* 207.)

battery to a dry type will be very successful and especially suited to the cyclist, who may use a storage battery as above mentioned for bicycle lighting. Contributed by

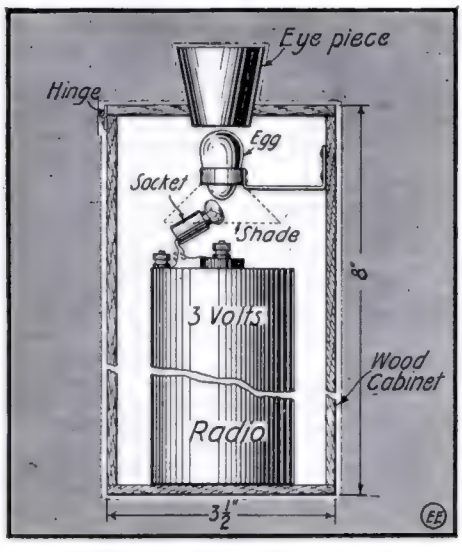
S. C.

The Marconi Wireless Telegraph Co., Ltd., reports net profits for the year ended Dec. 31 last of £232,700, an increase of £110,400. The report states that the directors decided to reduce the dividend on the ordinary shares from 10 to 20 per cent., in order to strengthen the financial position of the company.

A CHEAP ELECTRIC EGG TESTER.

The expression "fresh eggs" cannot always be depended upon, and my little device, herewith described, can be used in any suspicious case.

Make a wooden cabinet 8 inches high and 3½ inches wide. Then procure a 3-volt "Radio" cell and place in a box as



Inexpensive Electric Egg Tester.

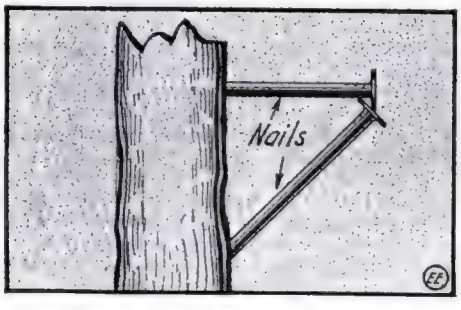
shown. In a small socket screw a bulb of at least 2½ volts, and with some stiff wire connect to battery as depicted. Now secure a wooden ring and fasten to a bracket in cabinet. If this cannot be done, make a ring from some very thick wire and tack to side of cabinet. Obtain a wooden cover, and after attaching a plain eyepiece, drill a hole in the center of the cover and fasten to box by hinges. Finally, bend the bulb in position, so that it is just in the middle of the ring when peering into the eyepiece. The hard rubber mouthpiece from an old telephone is a good substitute for an eyepiece.

When the light is turned on and the egg is in place the brilliancy of the bulb gives the egg a dim glow and the freshness is thereby determined by the quality of the glow. The darker the glow, the older the egg. A small lamp shade may be fastened to ring if desired. Contributed by

W. WESTON.

TEMPORARY POLE STEPS.

Cheap but safe pole steps can be made with 5-inch spikes. Spike one is driven in at an angle of 45 degrees, then spike two is driven in horizontally so that it rests on



Pole Steps Made From Nails.

the head of spike one. The wireless experimenter will find these useful for ascending trees and poles to erect his aerial.

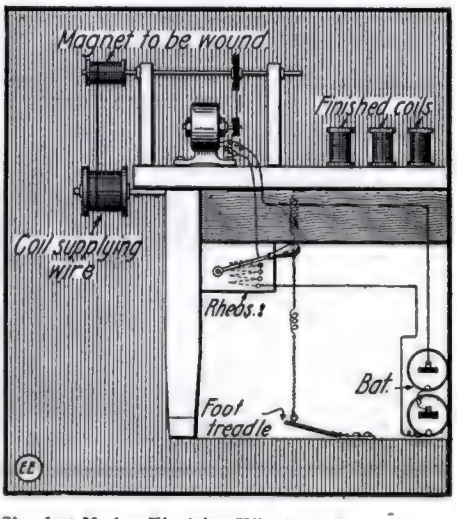
Contributed by E. R. THOMAS.

A SMALL WINDING MACHINE.

Every amateur, I am sure, knows how disagreeable it is to wind a magnet by hand. Herewith is described a simple machine involving only the use of an electric motor, a rheostat and some shafting.

First mount the motor about 8 inches from the edge of your table. Then procure and fasten two wooden posts in an upright position as shown. Before fastening, however, drill a hole on the end of each one, all the way through, to admit a long, slender steel rod. The latter is to be next obtained and a pulley fastened, as shown in sketch. The next step is to fasten a home-made rheostat on the left hand leg of the table and putting it in connection with some cells and one binding post of the motor. The sketch explains clearly all wiring. Now fasten a cord on the handle of the rheostat, attach a spring to it and fasten the end of the string to a foot treadle secured to the floor by hinges. (A piece of board will serve for a treadle.) Lastly, on the left hand corner of the table drive a long, thin nail, but without a head, as otherwise the spool cannot be slipped on and off. The device is now complete, and without a doubt will work satisfactorily.

To wind a magnet, put a spool of wire on the long, thin nail on the edge of the table and slip in a wooden bobbin to receive the wire on the steel rod, which is belted to the motor. By means of the foot treadle the hands can be used to control the winding of the wire evenly and the foot to control the current, by means of



Simply Made Electric Winding Machine for Experimenters.

the rheostat. If the wire begins to wind unevenly, raise your foot, thereby lifting the spring on the handle of the rheostat, which shuts off the current at once. For further operation, press treadle again with foot. Contributed by W. WALLACE.

THE CONSTRUCTION OF A FRICTIONAL ELECTRICAL MACHINE.

(*Continued from page* 206.)

moisture. Then the cushion should be connected to ground—a gas or water pipe, or merely a wire leading to the floor will suffice. Now if the cylinder is rotated rapidly a stream of sparks, that is, a discharge of electricity will pass between the points of the comb and the glass cylinder.

When the hand is brought near the end of the prime conductor a minute lightning discharge will occur between them and an electric shock will be experienced. *Under favorable conditions a spark as long as 2½ inches may be produced.* Any of the usual experiments in static electricity can be readily made with this device.

Contributed by FRED C. ARMAND.

WIRELESS DEPARTMENT

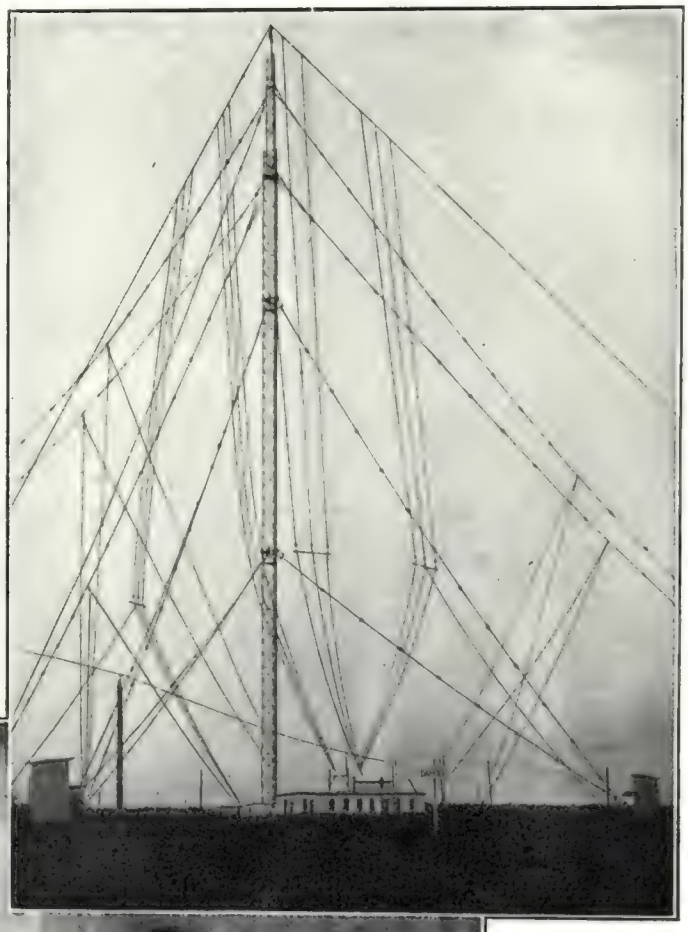
Sayville, the News-Way to Berlin.

NOW that the powerful German Wireless Telegraph Station, located at Sayville, L. I., has been taken over by the United States Government authorities by order of the President, to further the purpose of preserving our strict neutrality, this remarkable plant, about which so much secrecy has always been observed, has become of extraordinary interest to practically every one in this country.

Owing to the great secrecy which has always surrounded this station and the operation of same, there have been many wild tales prepared and published by various newspapers throughout the country, as to many *possible* and also a great many *impossible* schemes, which might have been employed in order to send undecipherable code messages to Germany, via the Nauen station, located near Berlin, which works in conjunction with Sayville in this country.

This plant is one of the largest in the world now, since the two new 400-foot steel towers have been erected and in view of the fact that the dynamo equipment for generating the wireless waves has been increased from about 35 kw. to 100 kw., or in other words the transmitting power has been tripled in order to insure absolute communication, under all conditions and particularly through the heavy static obtaining during the summer weather.

The illustrations herewith show the wonderful aerial structure at Sayville, which towers over 500 feet above the ground. The mast here shown is the central one of the three now available for the wonderfully enlarged antenna system.



Photos (C) by Underwood & Underwood.

Interior View of the Wonderful "Sayville" Radio Station. Above, the Aerial Structure 500 Feet High. Three Masts Are Now Used and 100 Kilowatts.

This station embodies a number of very ingenious and advanced features in radio installations not found in other stations, generally speaking, and about which very little has been said or published indeed. Among these important features are the means by which transmission and reception of signals is effected. To begin with, the high power used at Sayville has always been handled by automatic transmitting keys of the relay type. The operator, as here seen in the picture showing the interior of the station, operates an ordinary Morse key mounted on the desk in front of him. This small key controls the massive relays of the air-cooled type, of which there are three. Each relay has eight series contacts on it, and thus the current is broken through a plurality of 24 contacts. This conduces to rapid and positive operation of the transmitting circuit in sending out the dot and dash signals, which occur, of course, at the rate of many signals per minute. These relays are specially designed and are capable of operating at a speed of 150 words per minute.

Of course, no manual operator can attain a speed of much over 50 words per minute, even in a radio station, but the higher speeds such as mentioned are obtainable with this Telefunken system, as the transmitting has been done for many months and also at present, by means of a perforated paper tape, which is prepared on a machine similar to a typewriter, with a lettered keyboard. Once this tape is prepared with proper perforations corresponding to the dots and dashes of the Continental radio code, it is then passed through the automatic transmitter device, which actuates the heavy current relays aforementioned.

Suffice it to say that everything connected with this plant is of the very best and latest type. Particularly is this noticeable in the reception of radio signals from across the broad Atlantic, as for this purpose it is not necessary for the operator to wear the usual head 'phones on his ears, as will be noticed particularly in the illustration here shown.

The Above "Code" Diagram Shows How Secret Cipher Messages Could be Interspersed Through Regular Messages.

Signals coming in from Nauen, Germany, pass through a specially tuned microphonic form of amplifier, which may be observed mounted on the pedestal directly in front of the operator. This am-

plifier so marvelously increases the power of the signals as picked up by Sayville's antennae that when they reach their final stage they have been boosted sufficiently to enable them to operate a loud-sounding signal horn, so that the signals sound through the room similar to the striking of a piano string. Of course, it is perfectly feasible and possible, if desired, to make a tape record on a register of these signals as they come in, by hooking up the recorder to the final stage of the amplifier circuits.

As recently pointed out editorially in this journal, it is very true that, by means of the usual "cipher" code, it is undoubtedly possible for parties desiring to do so to send through a message which may appear very innocent indeed on its face, and yet when received in Germany, and by referring to a copy of the special "cipher" code involved, a distinct and very useful meaning may thus be carried through by such a message, even though *every person* connected with the Sayville station belongs to the United States Government personnel.

There have been many fantastic stories published in the newspapers, as aforementioned, and particularly with regard to a special invention of Dr. Isidor Kitsee, of Philadelphia, which some have claimed was used for the transmission of secret code signals *interspersed* with the regular signals employed for transmitting via Sayville ordinary-looking messages which the United States censors at Sayville passed through readily enough. While such an invention or code scheme could be used, it is doubtful that it was ever actually used.

It might, however, be of interest to point out how this could be accomplished. The code diagram herewith will show how the scheme would work in practise, and we think it is doubtful whether under ordinary conditions the United States Government censors would detect anything unusual about such a message. Furthermore, it could be *repeated a number of times* with variations, in order to make up a complete code for the alphabet. The fact also remains that such a lengthy repetition of a similar message for a period of several days, it is reported, was one of the deciding factors involved in the Government seizure of this station.

By referring to the code diagram here reproduced there is seen the word "Berlin" with corresponding Continental code dot and dash signals used in transmitting this word via radio. Glancing at the second line, it is seen how the spacing of the dots and dashes in a couple of letters comprising the word "Berlin" could be abnormally arranged. This abnormal spacing, strictly speaking, can be very minute, in view of the fact that if these particular signals were copied on a register at Nauen it would then be easily possible for the operator at that station to note the small difference in these "doctored" signals. By making these spaces different, or by using a certain space in a certain letter to represent a letter of the (cipher) alphabet it would be possible indeed to send a complete code message. By duplicating the same (regular message "apparently") time after time, it would ordinarily not arouse any undue suspicion.

Another scheme which could be followed would be the interposition of additional dot signals in the regular code make-up, as the third line in the diagram illustrates. Note the signal for "B," where an extra dot is added, and also the extra dot which is added in between the letters "E" and "R." It is quite improbable that these would be detected under usual conditions, especially as the messages sent through this station can be transmitted at a marvelous rate of speed.

This "doctoring" of the regular code signals could be managed by a small attachment of an electrical nature, perhaps, which could be fitted secretly to one of the automatic paper tape perforators or to one of the magnetic key transmitting mechanisms so as to abnormally space certain dots or dashes.

This matter is simply brought out to show that it is possible to conceive a secret cipher code, even in the face of strict censorship as this term is generally interpreted or understood, as for instance, prior to the complete occupation of this station by the United States naval personnel.

Why Sayville Radio Station Was Closed.

ADDITIONAL light has recently been thrown on the matter of the closing of the powerful German radio station at Sayville, L. I., and its reopening by a full Government staff.

A quantity of simple phonographic wax records, which were taken over a period of about one month prior to its seizure by Uncle Sam, were recored at the experimental wireless station of Mr. Charles E. Apgar, at Westfield, N. J.

We illustrate herewith the apparatus in Mr. Apgar's radio station and his wonderful amplifying set, whereby he has been enabled for the past few years to record faithfully all kinds of wireless messages on phonographic wax records. To put the matter briefly, the "canned" evidence that really closed the Sayville station, as far as the Telefunken company's operation of same was concerned, was started back on the 7th of June, 1915, on the advice of the United States Secret Service. W. J. Flynn, Chief of the Secret Service Bureau, took up the matter with Mr. Apgar at that time, and every night thereafter all of the wireless messages sent out from Sayville by the Telefunken operators were faithfully copied on a phonograph at the Westfield experimental station.

Mr. Charles E. Apgar, Radio Investigator of Westfield, N. J. Who Recorded on Phonograph Cylinders All of "Sayville" Radio Messages for One Month. The Evidence Helped to Close the Station by Uncle Sam.

Each morning the messages were transcribed from the wax cylinders verbatim, and sent at once to Mr. Flynn, either at New York or in Washington, wherever he happened to be on that day. While Mr. Apgar does not wish to commit himself unduly regarding this matter the Editor can truthfully state from what he has stated that it was really his absolutely faithful records of all of the signals sent out from Sayville that caused the United States Government to seize the famous station.

Further, it can be stated that secret messages, in code and otherwise, were thus sent along with regular censored messages, and it may be judged that some of these were incriminating enough in their nature, to cause the Government to act as it did on July 9, when United States Naval officers and operators took full charge of the Sayville Station.

It is interesting to note also that absolute evidence is available in writing in contradiction to many of the statements made by those connected with the Telefunken Co., also known as the Atlantic Communication Co. Of particular interest is the flat statement made by Dr. Karl Georg Frank, general manager of the Atlantic Communication Co., under date of July 18, 1915, when he stated in the public press that—"The statement that Mr. Apgar can record messages sent out by wireless on a phonographic cylinder is hardly worth discussing. That is physically impossible. I have never heard of it being done. If Mr. Apgar has accomplished it he should get his idea patented and perhaps we will buy it."

Interesting, indeed, is the evidence of another nature on the same subject and which is contained in a letter submitted to the Editors of this journal, bearing the above company's letter head, marked and dated Feb. 5, 1914, or about one and a half years previous to the above statement by Dr. Frank. In this letter addressed to Chas. E. Apgar the Atlantic Communication Co., per their Mr. M. Boehme, state that "they shall be pleased to have Mr. Apgar deliver some of his phonograph cylinders, containing wireless message records to them." This Mr. Apgar did on Feb. 9, 1914. This letter is signed by Mr. Boehme himself and also the records delivered are receipted for by Mr. Boehme.

The wireless method of transmitting intelligence is undoubtedly one of the most subtle and flexible known to modern science and it seems that whenever a system is devised to transmit "untappable" messages, then someone will find a way to decipher them.

Mr. Apgar employs an Audion detector in conjunction with the perfected Armstrong circuits whereby it is possible to get wonderful amplification of the signals received and also with but one Audion bulb. Undamped wave stations are picked up very clearly; so well in fact that at his station wireless signals from Nauen, Germany, have often been heard. With the

(*Continued on page* 215.)

The Hammond Radio Controlled Torpedo Boat

Although numerous and multifarious hair-raising inventions are claimed to be in use by foreign governments in the present titanic struggle for the supremacy of Europe, it is doubtful whether there is a more promising invention than that of the young American, John Hays Hammond, Jr.

Most of us have read in the daily papers from time to time of the wonderful wireless control effected by Mr. Hammond's invention, and we present herewith a photo of his latest torpedo boat, "The Natalia." The other photo shows Radio Operator Lee manipulating the wireless key at the Hammond laboratory on shore which controls the emission of wireless waves of various lengths, which when received by the radio antenna on board the automatic torpedo boat serve to make possible complete control of the movements of the boat.

The United States Government has detailed from time to time naval officers at the various trials conducted at the Hammond wireless laboratory at Gloucester, Mass. They have been highly pleased with the performance of Mr. Hammond's truly marvelous radio-mechanical craft, which seems to inherit almost superhuman intelligence. This may be better appreciated if we mention that from the time the boat has started from the pier until it returns from its run, which in some cases has totaled 28 miles, no human being is aboard. Truly uncanny is this meritorious device, and it bids fair to revolutionize modern warfare methods.

The United States Government is seriously considering the purchase of the entire rights to this radio control scheme, as worked out by young Mr. Hammond and his associate scientists and engineers. It would be of inestimable value for the protection of harbors, and as it can carry as much as 4,000 pounds of high explosives and as it also could be directed from shore directly at or toward any hostile warship it is seen that a very powerful weapon is thus placed in the hands of our coast defense corps.

It has been reported of late that the Japanese Government has been negotiating for the exclusive rights to this invention, but undoubtedly the American naval authorities will be wide awake to the far-reaching merits and properties of such a system and we hope that it will take up the matter very shortly, so as to control all rights thereto in the proper manner.

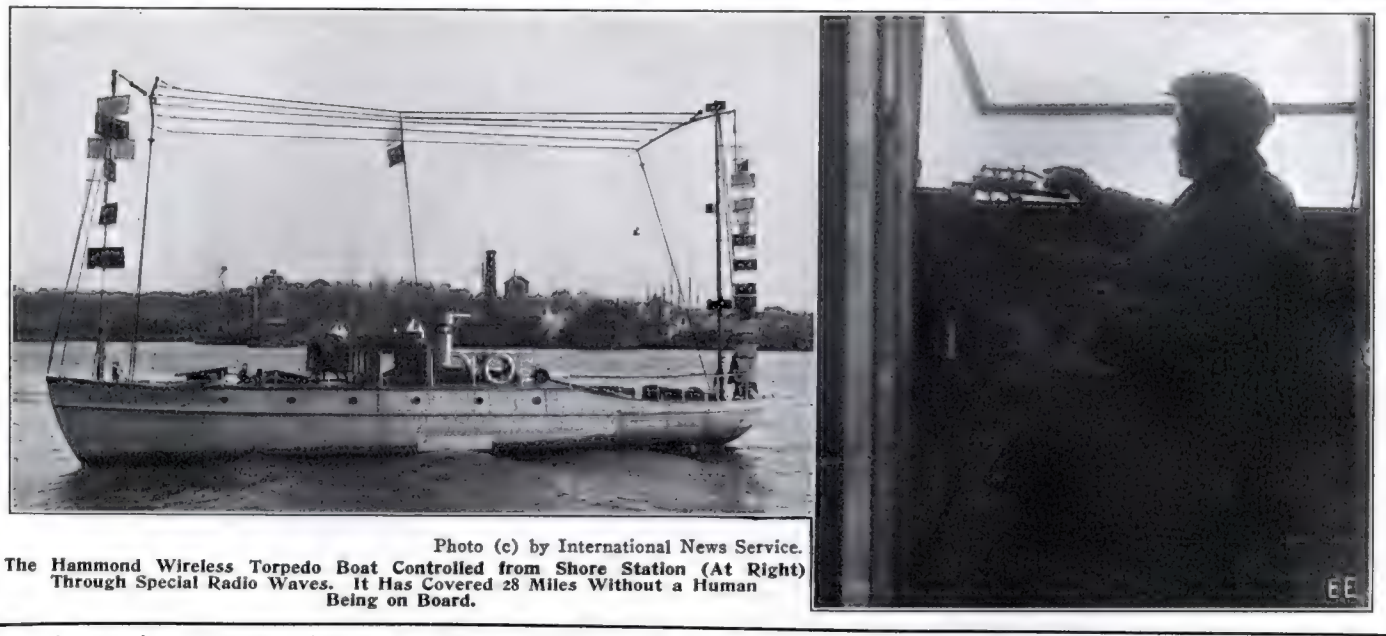


Photo (c) by International News Service.

The Hammond Wireless Torpedo Boat Controlled from Shore Station (At Right) Through Special Radio Waves. It Has Covered 28 Miles Without a Human Being on Board.

ON THE CAUSES OF IONIZATION OF THE ATMOSPHERE.

By J. A. Fleming, M.A., D.SC., F.R.S.

There has been much discussion among radio engineers regarding the possibility of an upper ionized strata of atmosphere which might affect long-distance day and night wireless transmission. After some explanatory remarks Dr. Fleming goes on to say: "Since quartz is not transparent to wave lengths of less than about 1,850 A.U. (Angström wave length units), and since this quartz light will not ionize air, the proof is tolerably complete that no true ultra-violet light ionization of air can take place at low levels in our atmosphere. If there is any such ionization as proved by the electric conductivity, then it can only be due to photo-electric action on dust, ice particles, or to radioactive matter in the sea or soil, or some indirect photo-electric process which yields negative ions.

"On the other hand, solar light, owing to the high temperature of the photosphere, probably does contain rays of short wave length lying within the Schumann (2,000 A.U. to 1,000 A.U.), and Lyman (1,000 A.U. to less) regions. Hence, even although the ionizing potential of oxygen, nitrogen, hydrogen and helium is 9 volts and upward, a true ultra-violet light ionization may take place in the levels of the atmosphere lying perhaps above 10 km. or 20 km. height.

"This, however, does not explain the possibility of a permanently ionized layer. It would merely account for a diurnal layer ionized by day or in the side of the atmosphere facing the sun and disappearing by night. To account for the permanently ionized layer, which it has become the custom, though as the writer thinks somewhat unappropriately, to call the Heaviside layer, it is essential to show cause for the production of ions of one sign only at some high level in the atmosphere. Good reasons have been given for supposing that the photosphere of the sun principally consists of carbon, probably condensed into flakes of soot or granules, and that the temperature, at any rate of its outer portions, is about 6,000 to 7,000 deg. C. Now we know that such incandescent carbon not only sends out ether wave radiation but emits positive and negative electrons, chiefly the latter.

"It is a comparatively easy matter to calculate the velocity and time of passage from the sun to the earth of such ions of various sizes under the action of solar light pressure. We start with the known facts that the Maxwell light pressure in dynes per square centimeter is numerically equal to the light energy in ergs per centimeter cube, and that the best value of the solar constant is 2.1 gram calories per square centimeter per minute, or 1.47×10^6 ergs are imparted per second to a perfectly black surface by normally incident bright sunshine corrected for atmospheric absorption. Hence it follows that the light energy per cubic centimeter is 49×10^{-6} ergs, and the light pressure nearly 5×10^{-5} dynes per square centimeter at the earth's surface. Light intensity at the sun's surface is, however, 46,000 times greater than at the earth's surface, and hence the light pressure at the sun is 2.3 dynes per square centimeter. These figures show that one cubic mile of sunlight at the earth's surface contains light energy equal to 14,710 foot-pounds, and the light pressure is 2.8 pounds per square mile. At the sun's surface the light is 58 tons per square mile and the light energy per cubic mile is 302,300 foot-tons, or energy enough to throw 20 of H. M. S. 'Queen Elizabeth's' 15-inch shells over the top of Mont Blanc.

"According to the most recent mathematical investigations by Prof. A. E. H. Love, who has confirmed results obtained by Prof. H. M. Macdonald, the full discussion of the problem of diffraction of long electric waves round a sphere seems to indicate that with waves 20,000 feet in wave-length diffraction alone will account for the daytime propagation of radio-telegraphic waves over such distances as 3,000 miles. Whether this be so or not, it is perfectly certain that some additional agency is at work in the night time. The onus rests on those who reject the theories built on atmospheric ionization to substitute for them some other valid explanation of the irregularities and generally greater range of night-time signaling.—*The Electrician*, London.

European Applications of Wireless Telephony.

By Frank C. Perkins.

THE accompanying illustrations, Figs. 1 and 2, show the switchboard and electrical apparatus utilized in the wireless telephone system developed at Paris, France, by the Compagnie Générale de Radiotélégraphie, and having a radius of action of about 200 kilometers (about 125 miles).

This French system developed by Colin-Jeance is supplied with current from a dynamo of 500 to 750 volts and from 3 to 4.5 amperes being used. The tension of the arcs in the oscillating circuit varies from 250 to 350 volts, a variable condenser being placed in parallel with the arcs. The current intensity used in the antenna is 3.5 amperes, while the microphone current intensity is .5 amperes, the wave length being 985 meters.

In the accompanying illustration may be seen apparatus of the Reineke wireless telephones for mines, utilized in Germany and in England, the photograph showing the operator speaking from mine cage to engine house.

Engineer T. M. Winstanley Wallis pointed out to the Institution of Mining Engineers that in Germany, as in England, the Government had for some time past urged the installation of telephones in mines; and as the usual troubles in the way of damage to wires occur equally in Germany as elsewhere, Herr Reineke, the inventor of this system, experimented with the view of overcoming these difficulties.

This system is in regular use in the Carolineneglück Pit, Bochum, Westphalia, where no other method of signaling is used and the Wireless Telephone Co., Ltd., of London, has been introducing the system in English mines. It is pointed out that in using the term "wireless" it is advisable to explain that the system is entirely distinct from that commonly used in wireless (or spark) telegraphy, as there are serious objections to such systems that would prevent its general use in mining work.

It may be said that in the wireless telephone the transmission and reception of the speech occur in a similar manner to the ordinary telephone, but there the resemblance ends. Instead of the current from the transmitter being conducted along the wire to the receiver it is converted to high pressure by means of a transformer contained in the telephone case. As the high pressure or secondary winding of the transformer is connected to the ordinary rails or pipes in the pit, it communicates to them a charge of electricity, which spreads over the whole system of rails throughout the pit, and varies with the fluctuations of the primary current in the transmitter circuit of the telephone. It is unnecessary to make any special provision to insulate the rails or pipes, or to connect the adjacent lengths electrically.

It is said that the invention resulted from the discovery that the conditions of distribution of electric charges underground are entirely distinct from the conditions that hold on the surface of the earth, and the working of the system largely depends on this fact. Speech can be received by connecting telephones to the rails or pipes at any point of the system, either by bridging a sufficient length so as to obtain a suitable difference of pressure, or by connecting between the rails and pipes if these exist; or, as is sometimes convenient in the case of portable instruments, by connecting to an antenna consisting of a loose coil of wire, which may be laid on the floor or hung on the timbers.

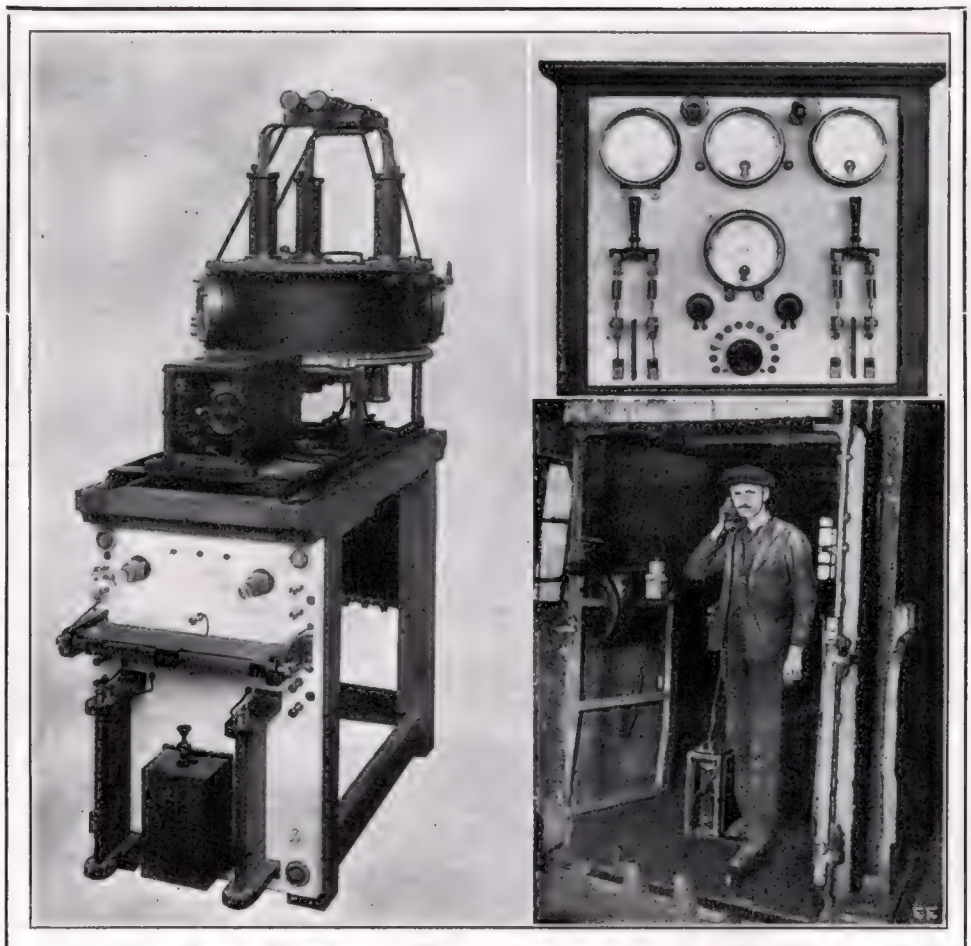
It may be stated that, as in the ordinary telephone, a bell is used for calling attention, the bell being operated by a specially designed relay. On the button being pressed at the transmitting stations all the telephone bells will ring and all the telephones can receive the message by taking the receiver off the hook, which operation cuts off the bell and connects the receiver in the usual manner. It is possible to tune the relays so that each will respond only to its own particular signal, and thus any one station can be called, but in mining work this is usually not necessary or desirable, and the different stations are called by giving one, two or three rings, as prearranged, while it is always possible, by a special signal, to call all the stations and speak to all simultaneously.

In the Reineke wireless telephone system for mines the current required is furnished by an ordinary battery; in fact, in outward appearance the telephones are exactly similar to an ordinary mining telephone. The portable instrument, which can be carried about and used in any part of the pit to which the rails extend, is contained in a strong metal case, the total weight being about 20 pounds. This telephone can either "ring up" the other stations or be "rung up" by them. A smaller or pocket instrument is also made, which can ring up other stations, but cannot be called by them.

It is pointed out that with the Reineke wireless telephone instrument for mines messages can be sent to or received from any of the fixed telephones, the only difference between it and the heavier portable type being that the other telephones cannot call it by ringing its bell. Thus each official provided with an instrument can give notice of any accident and ask for assistance from any point in the pit. A telephone can be fixed at any convenient position on the surface and connected to the headgear, if of iron, or to the winding rope or pipes which go down the shaft.

It is maintained that this telephone can speak to any of the telephones underground if necessary, but it is usually found more convenient to arrange for it to speak to the station at the pit bottom only and for this station in turn to speak to the underground telephones. In metalliferous mines, where a number of different levels run from the shaft, communication can be established from one level to another as required, the presence of the ore bodies not affecting the speaking in any way.

A most important application of the system is that of speaking from the moving cage to the winding engine house, and for the latter position the inventor has designed an ingenious method of operation. The telephone is mounted on a standard fixed close to the engineman's ear. On receiving a call he has only to put his ear to the receiver and a slight pressure is sufficient to switch in the telephone and enable him



At Left, New French, "Colin-Jeance" Wireless Telephone Apparatus. Top (Right) Switchboard For This Set. Below (Right) New Type of Mine Wireless. Telephone Devised by Herr Reineke, of Germany.

to communicate with the cage without removing his hands from the levers.

The advantages of this wireless mining telephone are many, and it is absolutely safe, there being no possibility under any conditions of producing a spark.

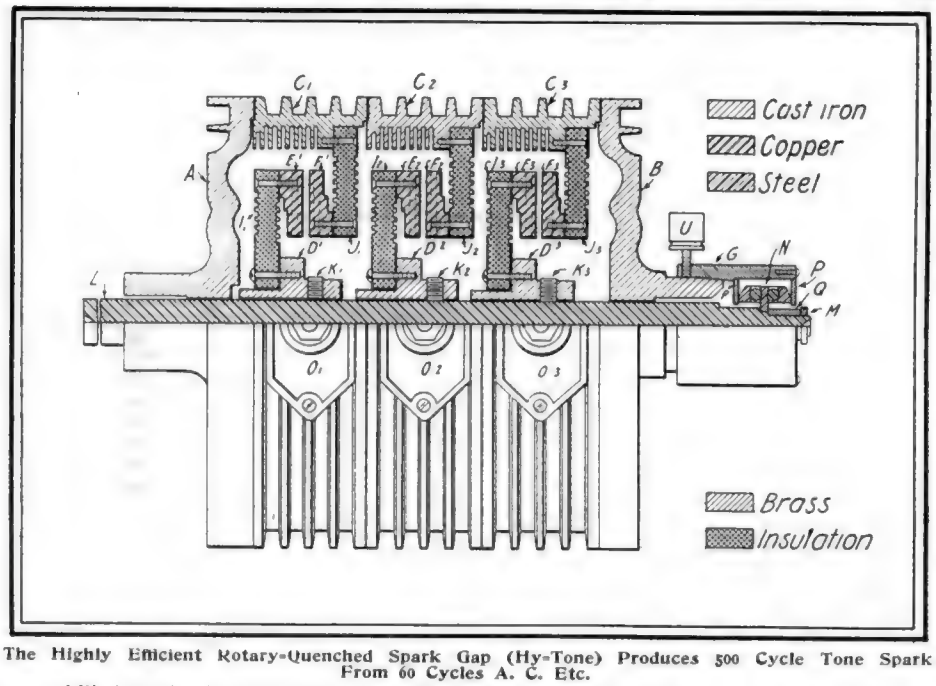
The inventor's claim that it provides complete security of communication, as there are no connecting wires to be interrupted and it can be easily removed from one place to another if required, while it cannot be affected by or affect other electric circuits in its neighborhood, whether these are direct or alternating currents conveying power or used for signaling, nor is it interfered with by ordinary wireless telegraph signals.

It is held that the opinion of the Continental experts who have exhaustively tested the telephone has been universally favorable and indicate that in this system a means of underground communication has been provided which is entirely free from any of the objections that have hitherto prevented the general use of telephones in mines.

THE HYTONE SPARK GAP.

The average experimenter is not very familiar with the working parts and operation of the hytone gap, about which much has been said. This new gap is of the rotary quenched type, several units being used in series, the number depending on the power rating of the set.

The construction is shown in figure which is a cross-section. A small motor (1-3 H.P.) is directly connected to the shaft "L," which rotates inside of the case housing "A C B." Bakelite discs "I" are screwed at their center to hubs "D" and at the outside to copper rings "E." Opposite each copper ring "E" are two copper half rings "F," supported on Bakelite pieces "J." The gaps are connected in series, and terminals are brought out from each through insulating bushings. A double thrust ball bearing "N" is mounted in a nut "G," so that the distance between the rotary and stationary electrodes may be adjusted. These gaps are made very accurately and very skilled mechanics are needed in building this device, as the distance between the rotary and stationary plates is only .003 inch (.075 mm.). The sparking surfaces are made of copper and both rotary and stationary plates are milled with 36 radial slots, so that when rotated at 1,000 R.P.M. the tone corresponds to that of a 540 cycle alternator. It is necessary that the width of the sparking segments be so proportioned that the sparks occur during not more than one-half of the total time, as otherwise the receiver telephone diaphragm is retarded on its excursion away from the magnet, thereby resulting in a decreased sound intensity. A great many experiments had to be made before such results were obtained.



The Highly Efficient Rotary-Quenched Spark Gap (Hy-Tone) Produces 500 Cycle Tone Spark From 60 Cycles A. C. Etc.

WIRELESS TELEPHONY DEVELOPMENTS.

For several years the problem of wireless telephony has been handicapped by the need of a microphone which could handle considerable currents, and thus little progress was made in this direction until investigators began to get away from recognized paths. Various systems have been tried from time to time, such as the T. Y. K. system of Torikato, the Janke system with the Poulsen arc, that of Ditcham, and that due to Colin and Jeance and others, but without any very great success. The new highly rarefied vacuum tube, however, has put a fresh weapon at the disposal of the investigator which promises to revolutionize present methods. Certainly, in one direction or another advances are being made very rapidly at the present time, and something in the nature of a revolution seems to be coming about. The reaction vacuum tube is now being applied to wireless telephony by the Marconi Co. The tube is partly used for the production of continuous oscillations and partly for the magnification of the signals that are received. One of the most interesting points is the fact that extremely small aerial currents, such as 0.2 ampere, are sufficient to enable speech to be transmitted a distance of 70 km. Telephone sets on this principle, delivering 0.6 ampere to the aerial, are now sufficiently commercial to be guaranteed for a distance of 50 km. between ships at sea, and thus radio telephony is coming into its own.

WIRELESS AIDS TELEPHONE SYSTEM.

Using the wireless in a business that is built entirely upon wires seems an anomaly.

But that is what the Pittsburgh & Allegheny Telephone Co. is doing. The telephone business, of course, depends upon wires. Without wires the telephone is useless, for invention has not yet evolved the wireless telephone in perfect form.

As a valuable supplement to the wire business, however, the wireless is a vital factor. The truth of this is attested by the fact that the Pittsburgh & Allegheny Telephone Co. has developed a wireless organization as a distinct department of its business. The main station is in Pittsburgh. Eight branch stations are established at points in western Pennsylvania, eastern and central Ohio and parts of West Virginia—throughout the territory in which the company operates its telephone system. Trained operators, working the company's secret code, keep in daily touch with the big station in the Miller building in Fernando street, Pittsburgh. The most distant station in the organization is at Erie, Pa., a distance of nearly 200 miles.

Wireless Set Used to Extend Operation and Usefulness of Regular Telephone System.

The need for the wireless became apparent when a storm of wind and sleet last winter threw down a great number of poles.

Now the company is ready. If another storm does the damage that was inflicted last winter the company can get into communication at once and continuously with every part of its system. The whole situation could be handled and directed right in the Pittsburgh office and the innumerable delays of last winter obviated.

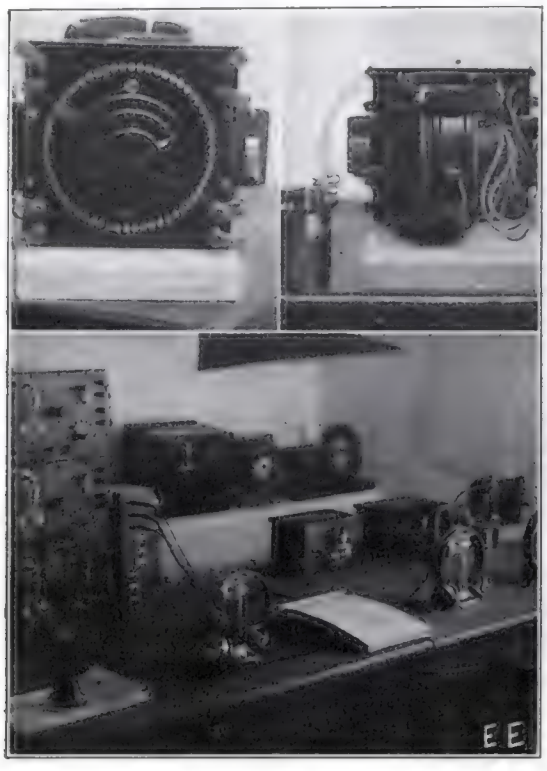
Practically all the apparatus in the Pittsburgh station was made in the company's shops in the Miller building. All the transmitting apparatus except the sending key is enclosed in the soundproof case. The receiving apparatus is placed on the shelf. The aerial is 170 feet long and 100 feet high, and is composed of four vertical and four horizontal No. 10 copper wires insulated with high-voltage insulators. The ground wire is composed of 125,000 circular mils area stranded copper rubber-coated cable.

In connection with their professional interest in wireless as an aid to the telephone business, Messrs. Muhlheizler and Weaver have encouraged the large number of young amateur wireless operators who have set up stations in western Pennsylvania. Largely through their efforts the Radio Society of Western Pennsylvania was organized.

Some Remarkable Results With Audion Amplifiers

By John A. Gardner and E. R. Isaak

I AM presenting herewith photos and drawings of some of our circuits, and will try to give a partial description of same. This covers our radio station at Eureka, S. D.



Views of Specially Arranged Loose Coupler and Complete Audion Receiving Set Used by Messrs. Gardner & Isaak Very Successfully.

As can be seen from the photo, our receiving set is of somewhat elaborate design. It consists briefly of tuning coil and rotary condensers, two audion detectors connected in cascade so as to amplify the signals, and three one-step amplifiers to amplify the signals as they come from the detectors. This arrangement makes use of five audion bulbs and their circuits for amplifying the signals. The amplification is so great that different parts of the circuits set up siren or whistling effects which effectually put a stop to the operation of the set or further amplification. In this article I will outline the special circuits we had to devise to make possible the efficient working of the many amplification units in one set, without being hampered by siren effects.

In Fig. 1 is shown the circuits for cascade connection of two audion detectors using one 6-volt storage battery to light both filaments. This is different from recently published circuits of the cascade connection using two batteries for heating the filaments, and it will be noticed that the 35-volt battery is shifted to a different part of the circuit in the first detector from where it would be if they were not connected in cascade. Tests seemed to indicate that this circuit not only amplified as much as the one using separate batteries for heating the filament but amplified quite perceptibly more.

This circuit may be used for receiving from the continuous wave stations by slightly changing the adjustment of the heating current and 35-volt battery current of the first detector. We use the magnet shown in the cut for helping to attain this adjustment, and also with the bulb we are using in the first detector now the magnet seems to increase the strength of signals from the spark stations. In use it is set in the position shown in the illustration. For the impedance coil shown we are using the secondary of a ½-inch spark coil. This is perhaps not the best that could be designed, but it works well. The iron core is, of course, left in place.

Fig. 2 shows the circuits of the plug box and amplifier. The plug box allows either one, two or three head sets to be connected to the third-step amplifier, the second-step or the first-step, and one head set can be plugged in on the second detector of the cascade set. This is invaluable for testing at any time the relative amount of amplification of the different amplifying units. The plug box is so wired that the head sets are connected in series. The weakening of the signals from plugging in two extra head sets is scarcely perceptible. This is owing to the extremely high resistance of the vacuum space in the amplifier bulbs. The additional resistance of one or two 4,000-ohm head sets makes little difference.

The first-step amplifier differs from the second and third only in the design of the transformer. It seems very necessary that the secondary of the transformer of potential circuit be not connected direct between the grid of the audion or amplifier bulb and the filament, but that a very small condenser, usually bridged by a very high resistance *made of slate or a pencil mark* be interposed in the circuit. The purpose of the high resistance is to prevent the bulb becoming paralyzed by static or strong signals, and should not be any lower than is absolutely necessary to accomplish this effect. The audion detectors seem to have only the condenser, but it is likely there is enough leakage through the wood of the containing box to accomplish this effect. In the second and third-step amplifier circuits shown the capacity between the two transformer windings is sufficient, and the illustration shows the adjustable high resistance made of slate that we are using.

As shown, the cascade-connected detectors are operated from one 6-volt storage battery, the first and second-step amplifiers from another, and the third-step from still another. This combination seems to be the only one we could work out that would give the maximum amount of amplification and operate without siren effects.

Fig. 3 shows views and part of circuits of our tuning coil. We consider this coil to be superior to any we have ever seen described. It will cover any wave length up to 16,000 meters or more without perceptible loss of efficiency from "dead ends" or from the volume of wire necessary to be used in a coil to cover the longer ranges, giving very close adjustment over the entire range. Every turn of the primary is inductively connected to every turn of the secondary, which is not the case where

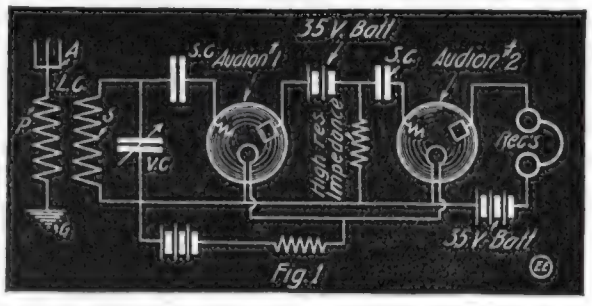


Fig. 1. Double Audion "Detector" Hook-Up.

tuning coil and loading coils are separate units, and the coupling of the entire tuning coil can be varied to about zero by simply turning a knob. The additional turns of wire up to the entire capacity can be added to either primary or secondary, or both, the windings being inductively connected in the most efficient manner, a flexibility not possible if tuning and loading coils are made in two or more separate units. They are arranged to be thrown in or out of the circuit by throwing the switch or telephone switchboard key shown in diagram, which dead-ends both ends of same when throwing them out of circuit.

It is a well-known fact that the audion is a potentially operated device, and that with a given tuning coil the signals are louder when the same wave length is tuned to in the secondary circuit, by using more wire and less condenser, than when using less wire and more condenser.

This effect can be carried out to the point where an ordinary variable condenser is adjusted to nearly zero and more wire is used in the secondary to get the correct wave length with a very perceptible gain

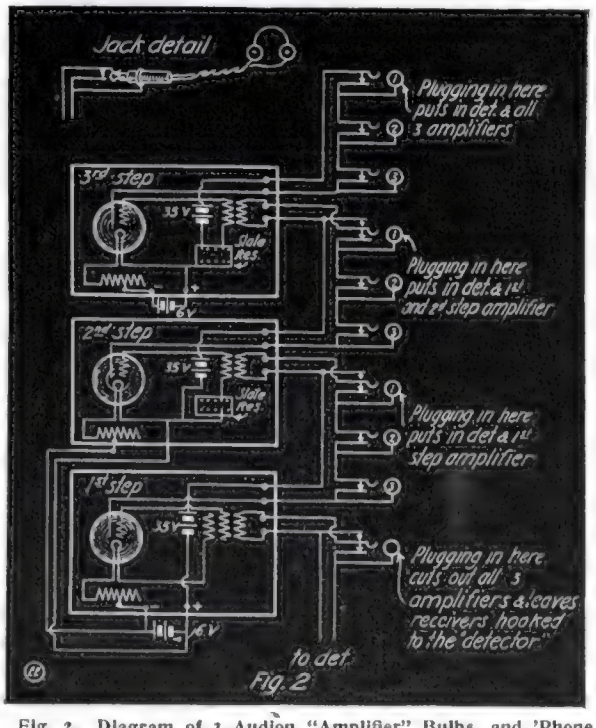

Jack detail
Plugging in here puts in det. & all 3 amplifiers
3rd step
35 V
Slate Res.
6 V
Plugging in here puts in det. & 1st and 2nd step amplifier
2nd step
35 V
Slate Res.
Plugging in here puts in det. & 1st step amplifier
1st step
35 V
6 V
Plugging in here cuts out all 3 amplifiers & leaves receivers hooked to the detector
to det.
Fig. 2

Fig. 2. Diagram of 3 Audion "Amplifier" Bulbs and 'Phone Jack Circuits.

in the strength of signals. The flexibility of this tuning coil allows this to be done, and hence the great superiority of this design for a tuner to be operated in connection with an audion. Arlington tunes in here with but 29 turns of the original primary winding, while for the secondary we use zero condenser and *five times* the original secondary winding.

Our aerial is "T" shaped, and each half

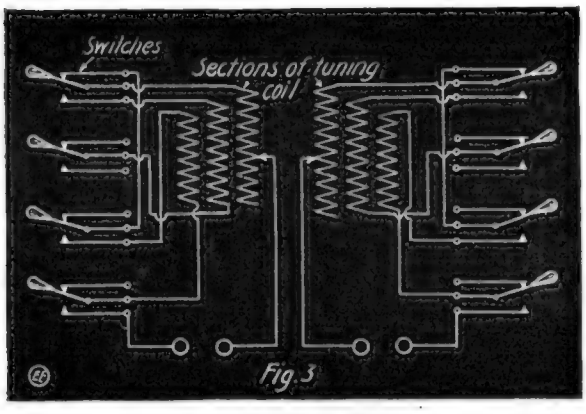


Fig. 3. Special Hook-Up of Loose-Coupler Windings to Prevent "Dead-Ends."

is about 500 feet long and averages 75 or 80 feet high.

We can hear Arlington at our station, Aberdeen, S. D., very plainly every day at this time of year unless there are unusual conditions, and are now doing most of our receiving by day. We can also hear Springfield, Ill., send out the time nearly every day at noon, and usually it comes in quite loud. We are unable to hear Key West, or San Diego or Mare Island on the Pacific Coast at this time of year, but we very often heard them in the daytime when they sent out the time during the winter.

The photo of tuning coil is not very good and does not show it as we would like. Also there will be seen a coil lying on top of this coil or tuner, and a condenser forming a separate circuit that has nothing to do with the tuning coil proper and should have been left out of the picture. When the static is extremely severe we couple the tuning coil so loosely that no signals at all come through, then we tune in this extra coil and condenser to the wave length, and by tipping it slightly to one side it forms the coupling between the primary and secondary of the tuning coil, enabling us sometimes to read messages that otherwise are drowned out by static.

[*Editor's Note.*—A resistance of 9,000 ohms has been found very good for the iron wire core impedance coil linking up the two audion detectors in diagram Fig. 1.]

WHY SAYVILLE RADIO STATION WAS CLOSED.

(*Continued from page* 210.)

apparatus here shown working at full activity and when hooked up with his super-sensitive, special type, microphonic amplifier in conjunction with the Armstrong Audion circuits the signals are so loud that one can hardly stay in the room while they are "coming in" through the loud talker horn shown at the right of the picture. When the wireless room windows are open signals have been heard 600 to 700 feet away very clearly innumerable times. Mr. Apgar is certainly to be congratulated on his excellent work. Thus the experimenter comes into his own.

OUR SUPPLEMENT

THE supplement accompanying this issue of the *Electrical Experimenter* shows the working drawings for the construction of an improved type wireless loose coupler, capable of tuning in messages up to 4,000 meters wave length, when used with an aerial at least 80 to 100 feet long, comprising four to six strands, spaced three feet apart and elevated 75 to 80 feet above the ground. With larger aerials, of course, much greater wave length ranges are available with this instrument.

The drawings explain themselves and we will cover the principal points involved in making the coupler briefly.

The primary and secondary coils are provided with tuning switches instead of sliders, in accordance with the best practise now followed in building such apparatus, and thus positive contact is always assured throughout these circuits. Each winding consists of one layer of wire, wound on evenly, and the taps for the various switch points are provided for while winding the coils by simply leaving a loop in the wire and twisting this loop so that it will hold itself in place. The taps are evenly divided as regards the total turns on the coils with respect to the secondary winding. In the primary coil one blade of the switch has its points connected up to successive individual turns; while the second blade of the switch controls grouped units of turns, which units are equal in number of turns.

The construction will be grasped by looking at the drawings closely; full detailed figures are not suggested for the reason that most everyone will make up the cabinet to suit himself from materials at hand. This coupler may be made larger or smaller, as preferred.

The primary interpolating switch is simply constructed and the smaller knob on same is joined rigidly to a movable center shaft which is insulated from an outside hollow shaft, and in this way two circuits are carried up through the central "combination" switch post.

A loading coil is suggested to be used with this coupler, although it is not absolutely necessary, excepting for tuning in wave lengths above 1,500 meters. This is shown in the drawing herewith, as are also details of wood or fiber form, on which to wind it.

There are eight tap leads brought out from the loading coil and equally divided, as perceived. This includes the starting and finishing leads from the coil; the wire is simply looped out successively through one of the slots as the coil is wound, in order to provide for the eight tap leads, which connect to the loading coil switch points on the hard rubber switchboard front of the primary cabinet of the coupler. The loading coil is made very thin, as will be noted, so as to give it the well known "pancake" coil effect, which is very desirable in wireless circuits; a thick coil of this type is not recommended.

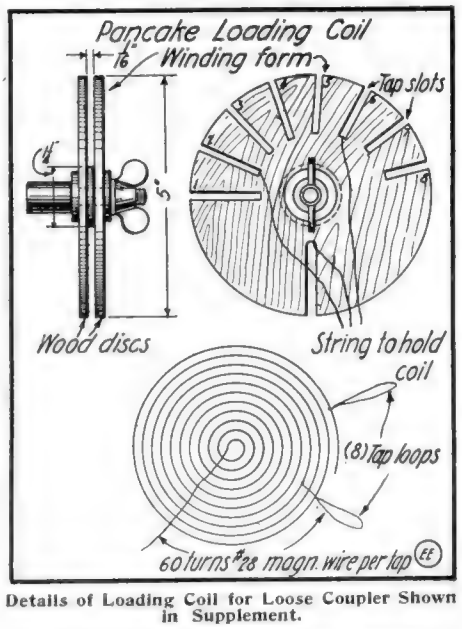
Also in winding such a coil as this for wireless circuits care should be taken to "cross over" the turns or "stagger" them as much as possible and not to keep them even, as in winding magnet coils. This is done to minimize the effect of distributed capacity between turns.

A word of caution to those making such instruments as this with tap leads brought out along the coils should be noted, and the point in mind is this:

Such tap leads should in every case be short-circuited at their twisting point where they leave the coil, so that when a number of sections of such a winding are in use the current will not have to pass through one section out and around through such a tap lead or loop, back to the next section. This would greatly reduce the efficiency of the coil. Therefore the wire lead should have its insulation scraped off about ¼ inch from the winding layer proper, and preferably this point on the lead should be soldered. For those making use of Audion or Fleming valve detectors, which are potentially operated, it is best to wind the secondary of the coupler with much finer wire, say No. 30 or 32 B. & S. gauge. Some writers recommend as fine as No. 36 wire for such detectors, but it is doubtful if the damping and resistance (which are directly related) do not reduce the efficiency of the circuits of the coupler, and that the gain created by using a greater number of turns of fine wire to increase the secondary coupler potential is not off-set by the high "damping" value of the circuit. This can be experimented with, of course, by the operator making use of such apparatus.

Regarding the secondary, spring contacts are arranged inside the secondary form and which make contact with the two slider rods, upon which the secondary moves back and forth, and in this way current is carried in to and out of the secondary winding.

The arrangement shown for the secondary switch will be found very efficient and handy indeed; also this one switch knob will serve two purposes, viz., to adjust the inductance value of the secondary, as well as to vary the coupling or distance between the primary and secondary windings, by moving the secondary in to and out of the primary in the usual way.



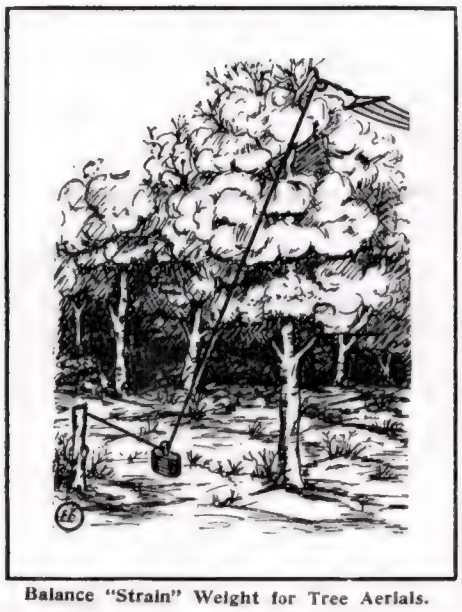
Details of Loading Coil for Loose Coupler Shown in Supplement.

INTERESTING NEW INVENTION

A door-knob connected with an electric lamp that may be switched on by pressing a button has been patented by a New York inventor. The invention is expected to help materially in the sometimes difficult process of finding the keyhole after dark. The door-knob is illuminated. The same principle is applied to the doors and dials of safes.

AERIAL WIND STRESS PROTECTION.

Considerable trouble is encountered by amateurs utilizing trees for their aerial supports, by the breaking of the aerial wires, when the wind blows.



Balance "Strain" Weight for Tree Aerials.

The common method of overcoming this is to allow considerable slack in the wires, which decreases the efficiency and also gives the aerial a saggy appearance.

However, in the illustration herewith given is shown an easier way of eliminating this disadvantage, which will keep the aerial tight at all times, regardless of how strongly the wind blows or how much the tree sways.

A pulley is hung loosely on a limb at the top of the tree and a small rope run through it to the aerial spreader, the other end of the rope being fastened to a post on the ground, 20 or 25 feet from the base of the tree.

A 50-pound weight (a railroad iron is suitable) is attached to the rope, as described, and perfect protection is now insured against snapping wires. Contributed by ARTHUR DARLING.

TRY THIS ON YOUR VICTROLA

Can You Read This Message?

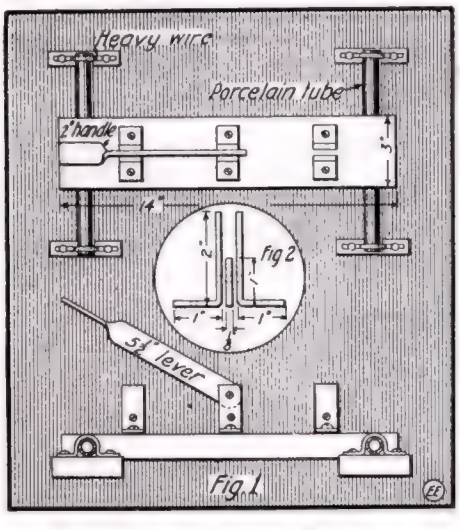
HOME-MADE LIGHTNING SWITCH.

The high price of lightning switches prevents many wireless amateurs from protecting their homes or wireless stations properly. The one here described is cheap, well-insulated and capable of carrying 100 amperes.

The switch base is made of well-seasoned wood, 14x3x1½ inches. The jaws and switch lever are made of strip brass or copper, 1 inch wide and ⅛ inch thick. The lever is 8 inches long, constructed as shown in Fig. 1. An ⅛-inch hole is drilled ½ inch from the end, while the other end is twisted by placing in a vise, so as to make a handle 2 inches long. The jaws are built as shown in Fig. 2, standing 2 inches high with 1-inch flanges. A piece of brass 1 inch square and ⅛ inch thick is placed between the jaws to properly space them, and also to stop the lever in the proper position. An ⅛-inch hole is now drilled through the jaws and a piece of strip copper or brass, ½ inch from the bottom, and a rivet inserted and upset.

The jaw holding the lever is made similar to the above, with the exception that the hole is drilled ½ inch from the top instead of the bottom; no piece of strip copper being inserted between the jaws, the switch lever taking its place.

To insulate the switch properly two 6-inch porcelain tubes are used. Holes are bored a little larger than the diameter of the tubes, 1 inch from the ends of the base, and the tubes are slipped through and wedged. Four standards are now made upon which the ends of the tubes are clamped with heavy copper wire and the



Home-Made Lightning Switch.

standards are now screwed to the side of the house or shop, convenient to the lead-in wire. If the switch is not protected normally from the weather, it should be covered with a box. Contributed by ARTHUR DARLING.

SOMERVILLE, MASS., BOY RADIO OPERATOR.

The management of the Hotel Thorwald, Gloucester, is much pleased with the work of one of its employes, Willis Herbert Farnum, who has installed a wireless station there which allows the guests the privilege of receiving wireless messages of all the latest news, including sports, war news, movements of vessels, weather reports and the correct time. The station is in touch with stations as far north as Halifax, N. S., and as far south as Key West, Fla. Mr. Farnum has been an interested student of wireless telegraphy for several years, and is now gaining considerable fame as an expert operator.

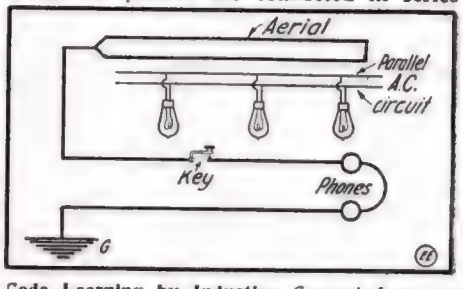
NAVY ENLARGING WIRELESS STATION AT NEW ORLEANS.

Work on enlarging the naval radio station at New Orleans and installing more powerful instruments is nearing completion.

As rebuilt the New Orleans station will be the second largest of those owned by the Government. It will have a power of 30 kilowatts against the five of the original plant, and will be used principally as a relay for messages between the Atlantic and Pacific Coast stations and, when necessary, for communication with Panama.

A BATTERYLESS CODE TEACHER.

Having an aerial parallel to the A. C. electric light wires, I hear a steady buzz, when the phones are connected in series



Code Learning by Induction Current from 110 Volt A. C. Circuit.

with the aerial and ground, and have used it to advantage, as shown in the diagram, to practise the code. No buzzers or batteries are needed.

Contributed by R. SHANAHAN.

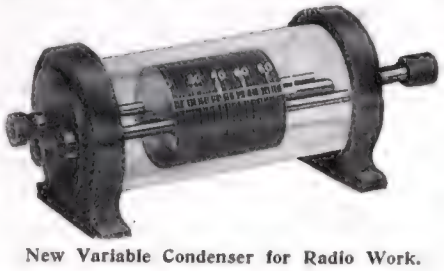
NEW HIGH POWER GOVERNMENT RADIO.

The Navy Department is planning to construct a new high power radio station on Puget Sound, probably at Keyport, near Bremerton, Wash. The plant will be one of the most modern stations ever built and will have towers 400 feet high. It is also reported that another wireless station will be erected on the Vopper River Flats at Cordova, Alaska.

A NEW RADIO VARIABLE CONDENSER.

A new variable condenser, which works different from any of the other condensers on the market, has been invented by Eugene Turney, the originator of the Crystaloi detector.

The photograph herewith illustrates the complete condenser, which consists virtually of 35 circular aluminum plates, supported on two rods, one of which is half insulated, and which are enclosed in a glass cylinder. On each side of the plate is an insulated washer, and the plates are alternately arranged on the rods so that when they are moved by means of a small handle, as shown, one plate will make contact with one rod, while its adjoining plate makes contact with the other rod, and so on. In this way the plates are varied just by pulling them in or out and consequently varying the capacity. When they are fully in, the capacity is at zero; as the plates are not then connected to the metallic rods, since one of them is half insulated, therefore that portion is at the end.

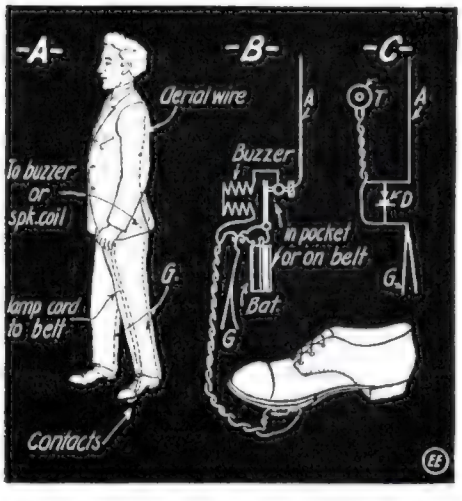


New Variable Condenser for Radio Work.

With such a condenser short circuits are eliminated, which is the main difficulty in the present rotary variable condenser. Two types of such condenser are now being marketed, one of 35 and another of 50 plates.

WIRELESS AND MIND READING.

MANY acts before the public profess to transmit mind waves by mental telepathy, but whether they do or not is always the debatable question. However, for the parlor entertainer it is a very simple manner to carry out such an act with the aid of a miniature wireless outfit carried on the person. For ordinary distances up to 50 or 75 feet and more, a buzzer of ordinary type will serve as the transmitter, excited by a flashlight battery, and both carried in the pockets or on a belt. Down the leg is run a 2-conductor cable of lamp cord connecting to the battery and buzzer as seen at Figs. A and B. For aerial and ground a piece of lamp cord or high tension cable is carried up the back under the coat and down the pant leg as shown. No danger whatever is present from accidental shock, etc., with a buzzer, but for the most reliable work in the largest auditorium, a small spark coil of ⅛ to ¼ inch spark capacity, should be used. A ¼ inch coil can be run, for instance on 1 or 2 dry cells of flashlight battery, so as to keep the power down. In this case, extra heavy high tension cable must be used for aerial and ground. The coil or

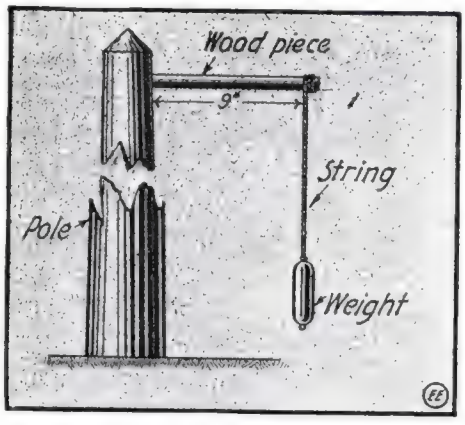


Wireless for Fake Mind Reading Act.

buzzer circuit is closed thru contact pieces of brass secured under the sole of the shoe. The receptor comprises a detector (preferably a Radioson or other constantly adjusted type), and a wireless receiver T, (1,000 ohms resistance is best). The regular telegraph code is used and by learning this, both parties can work together nicely. It works out like this: A common act is that where a gentleman goes about the auditorium or parlor asking each person the name of the song they desired played by his accomplice on the stage, who is usually a lady, who can easily cover over the telephone receiver with her hair without exciting suspicion. Now most "sharpers" who see such acts at once deduce that all of the gentleman's queries are keyed by the way in which he expresses each request of his accomplice or rather by the juxtaposition of certain words in the query. This is a common scheme long used for the purpose, but to-day something better is required in high grade entertainments. Hence with this wireless scheme, the speaker has them all guessing because each request can be stated in exactly the same way and tone of voice. For instance, "Play this gentleman's selection," etc., and this same line can be used right along, changing it to suit when referring to a lady, of course. It is usual to number the songs for such an act and then the "wireless actor" simply has to transmit the number to his assistant on the stage. For example, if "Annie Laurie" was No. 17 on the *made-up list*, then 1 and 7 in code are transmitted via radio, 1 being equivalent to dot, dash, dash, dot, and 7 to dash, dash, dot, dot. By knowing the code, the name of a song whispered to the gentleman can be transmitted if perchance it didn't happen to be on the numbered schedule. A quenched spark gap should be used on the spark coil to eliminate the noise, and the buzzer or the coil must be specially built or well muffled to prevent the vibrator hum being heard by the auditors.—H. W. S.

HOW TO PLUMB AN AERIAL MAST.

To plumb a mast fasten to the top of it a piece of wood projecting out about 9 inches. Suspend to this a window iron or other weight by means of a string, bringing the



Plumbing an Aerial Mast.

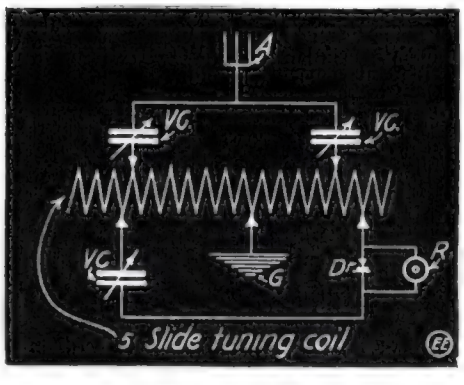
weight near the ground. Now adjust the pole on parallel with the weighted string, allowing 9 inches between them, thus creating a perpendicular pole.

Contributed by
WALTER FRANSEEN.

ELIMINATION OF INDUCTANCE DISTURBANCES.

A clever method has been suggested and found to be successful in practise for the elimination of sounds in wireless telephone receivers produced by neighboring power lines. This method is depicted in the drawing, which is self-explanatory. A five-slide tuning coil, three adjustable condensers, detector and telephone receivers are necessary. Probably a three-slide tuning coil will fulfil the purpose if the end connections on the coil are used in place of two of the sliders However, the five sliders give a wide range of adjustability which allows of some wonderful tuning possibilities, including the tuning out of unwanted radio signals. It may be found somewhat difficult at first to manipulate the five sliders, but a little practise will soon familiarize the operator with the best methods to pursue.

Contributed by F. KANE.



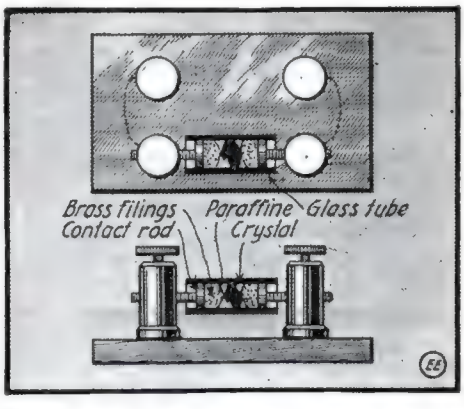
A Five-Slide Tuning Coil Proves Highly Selective.

A "PERMANENT" WIRELESS DETECTOR.

No doubt many an amateur has gazed at the advertisements of "Permanent" detectors and wished he possessed one of these *wonders* that can neither be knocked out, burned out nor kicked out, and that eclipses all others in sensitiveness. But usually the price is a little "steep."

The detector I shall describe *is* permanent, and it takes a stronger-than-usual current to burn it out. The sensitiveness all depends upon the construction.

Select a piece of thick annealed glass tubing (such as water gauge tube) with a bore of ¼ inch. The tube should be 1 inch long. Get a piece of galena that will closely fit into the tube. This galena must be *sensitive*, and with as many sensitive spots as possible. I remember breaking up several ounces of galena before I found the piece I wanted. Slide this crystal into the middle of the tube and seal it in place by letting a little red sealing wax run in along the inside of the tube from both ends. A candle is very good for this operation. But be sure that the crystal is *not* covered up. There should be at least ⅛ inch of open space on the crystal at each end, and these two spots *must* be sensitive, which means a nice place for trouble if they are not. Take a pin and cut off the



Permanent Detector Easily Made.

wax evenly all the way around the inside of the tube (see drawing).

Next, some metal (brass) filings are filled in at each end, making contact with the crystal, and the contact rods are pushed in after the filings. These contact rods are common switch points with the heads filed down to fit the tube. These rods fit into two binding posts as per drawing, which completes the working parts. The whole is then mounted on a base with two other binding posts for connecting to the circuit.

It will take a little time and patience to test out the crystals and assemble the detector, but once in operation it *stays* in operation. Drop it on the floor, sling it around, shake it! So long as you don't hit the tube with a hammer the detector remains as good as ever.

If no suitable galena can be found silicon can be used.

Contributed by
EARL H. SWANSON.

HOW-TO-MAKE-IT DEPARTMENT

This department will award the following monthly prices: FIRST PRIZE $3.00; SECOND PRIZE $2.00; THIRD PRIZE, $1.00.
The idea of this department is to accomplish new things with old apparatus or old material, and for the most useful, practical and original idea submitted to the Editors of this department, a monthly series of prizes will be awarded. For the best ideas submitted a prize of $3.00 will be given; for the second best idea a $2.00 prize, and for the third best a prize of $1.00. The article need not be very elaborate, and rough sketches are sufficient. We will make the mechanical drawings.

FIRST PRIZE $3.00.

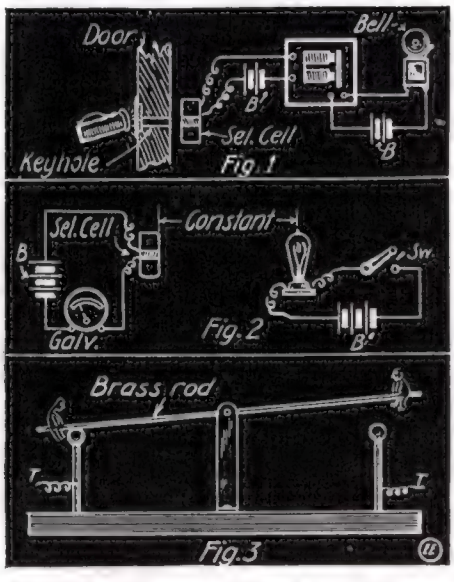
A FEW ELECTRICAL KINKS.

Two Uses of a Selenium Cell.

To make a selenium cell burglar alarm: Place the cell (Fig. 1) inside the keyhole of door or safe and connect with bell and battery, using a relay. When burglar flashes lamp the cell closes relay, which rings bell in local circuit.

Using a selenium cell to test candle power of lamps: Connect as shown in Fig. 2, using same voltage each time. Use a galvanometer, which can have its scale specially calibrated. The meter may be calibrated by using lamps of different known candle power.

A novel static see-saw is illustrated herewith and can be worked on any Whimshurst machine. Connect the two chains T T to



Some Handy Electrical Kinks.

the poles of the machine and start the see-saw. The action is simple. The one pole attracts the brass rod and then repels it, the brass rod being charged with electricity. This is distributed all over the surface and is attracted by the other ball, and so on. Small and very light cardboard figures may be mounted on the ends of the rod. Brass balls can be tried on the rod, placing them opposite the fixed balls.

Contributed by EARL DIETRICH.

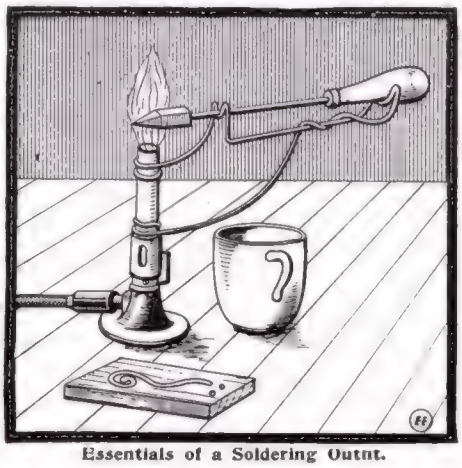
HOW TO DO SOLDERING.

Although soldering is not under the head of electricity, it is so closely allied to electrical work, not only in practical but experimental and wireless work, that any information on it ought to be welcomed by readers of this magazine who still twist their wire tightly and expect to get a *perfect,* low resistance joint.

To heat the soldering iron you will require a stove or fire, but the best and most convenient method is to use a Bunsen gas burner. A wire support for the iron should be made as suggested in the sketch.

The "dip" solution may be made by dissolving zinc in muriatic acid until it is completely "killed" or ceases to bubble, and then diluting the acid with about five times its volume of clear water. This is poured in a porcelain or glass container and is kept handy near the burner for convenience.

The flux should by all means be non-corrosive; tallow is as good a thing as can be obtained, although hard to work with. There are many preparations on the market that are good (as Solderall, No-corrode, etc.), and it is very much easier and cheaper to buy a small can of some reliable make. By all means use soft solder; wire solder fills every demand.



Essentials of a Soldering Outnt.

Light the burner and adjust it till it gives a clear, blue flame, and lay the iron on the support so it is in the upper or hottest part of the flame. Meanwhile clean the parts to be soldered and give them a thin coat of flux. *Remember, metals MUST be bright and clean, else the solder will not "flow."*

When the iron is hot enough (not red hot) dip it for an instant into the "dip" solution, then touch it to the solder and give it a good coat. This is called *tinning.* The parts should now be tinned by passing the iron over them, then press together and rub iron on top, resulting in an electrically perfect joint. Be sure the solder flows evenly and smoothly through the joint.

The iron is hot enough when green flames are seen around its edge, and it may be necessary to file a clean surface on it if it gets red hot, as this burns the solder off. In closing, I repeat: Always keep the iron well tinned and the parts well cleaned, and success will invariably follow.

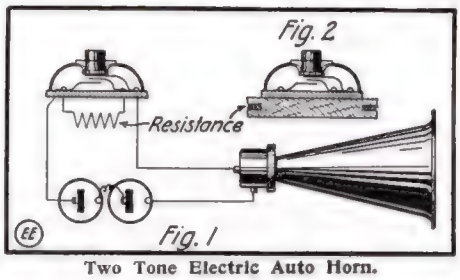
Contributed by THOMAS W. BENSON.

SECOND PRIZE $2.00.

A DOUBLE-TONE AUTO-HORN.

By inserting a little resistance in series with an automobile horn or other electric signal the tone may be lowered more or less, depending upon the amount of resistance set into the circuit.

Oftentimes it is very undesirable to blow an auto horn while passing through a town



Two Tone Electric Auto Horn.

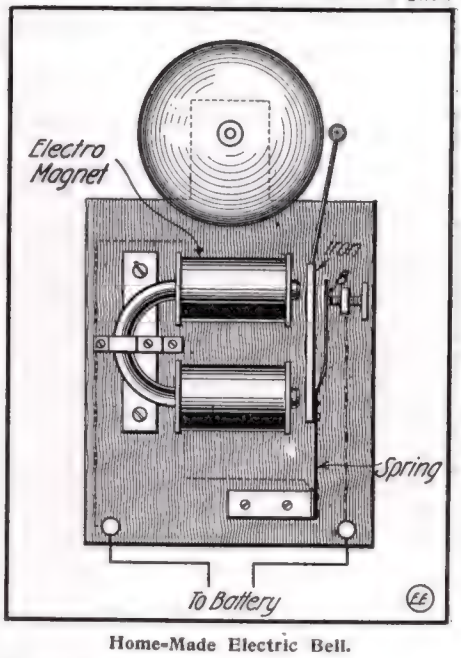
at late hours, as some electric signals are very unpleasant to the near-by inhabitants. A simple way to work the above scheme out is to make a double contact push button, which is very clearly explained in the diagram given herewith.

Two or three feet of No. 22 or 24 soft iron or German silver insulated wire will be about right for the average electric signal, such as is used on automobiles and motor boats. A very convenient place for the resistance can be made by cutting a groove in the base of the push button, as shown in Fig. 2. By pressing the button slightly the signal will sound about half tone; press the button a little harder and the signal will sound at full tone. Contributed by H. CORCELL STUART.

THIRD PRIZE $1.00.

A HOME-MADE ELECTRIC BELL.

To make a cheap yet satisfactory electric bell cut out a small board, six inches square with a one-inch square projection at one end, as illustrated. To this board screw a block of wood, 3x½x½ inches, and fasten an electromagnet to the latter, as shown. In the center at the bottom of the board attach another block, 1x½x½ inch, and to this screw a piece of clock or brass spring with a soft hammer affixed, which should be long enough to extend past the two ends of the electromagnet. On the inside of this spring rivet a small brass strip and then solder a piece of silver on it. Then bend the brass strip, as depicted in sketch. A small thumbscrew should now be attached in such



Home-Made Electric Bell.

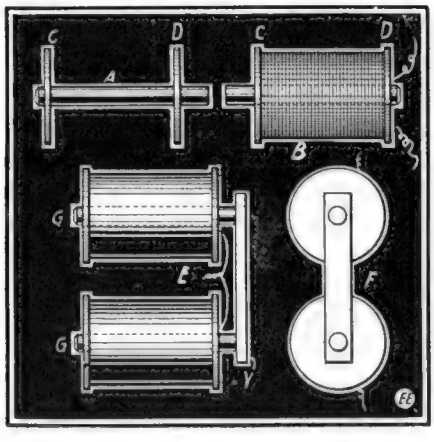
a manner that the silver point of same touches the silver on the strip. An old bicycle or alarm bell gong is fastened by a screw to the projection at the top of the board, and the wiring arranged as per outline herewith given. We now have a complete and useful little electric bell that will be found very serviceable. If desired, two binding posts may be fastened to the end of the base. Contributed by

WILLIAM WINTERS.

HINTS ON ELECTRO-MAGNETS.

The principle of most electric instruments, as well as machinery, is based upon the electro-magnet, for the construction of which the following directions will be found very serviceable.

First, remember that the nearer to the iron core the coils are wound, the stronger the magnet. Secondly, a magnet does not increase in strength materially after the wire is wound on deeper than the diameter of the core. That is, if a core is ½ inch in diameter it should not be wound to a diameter of over 1½ inches. If a weak current is used, wind with small wire; the less current utilized, the smaller the wire. For telegraph coils and bells use about ½ inch core 2½ inches long, and wind to a diameter of 1 to 1¼ inches with No. 24 or No. 26 copper wire. To make a single magnet, take a large wire nail or soft round iron bar 2½ to 3 inches long. Cut a circle of stiff thin wood or cardboard and, after fastening it on the bar, wind with No. 26 or 28 magnet wire, taking care not to injure the insulation. Apply a coat or two of gum shellac or dip in melted paraffine for a few minutes, and dry. Fig. A shows bobbin of magnet ready to be wound; at Fig. B it is already wound. C and D are the discs of wood or cardboard, and E illustrates a double magnet. A side view of the magnet is shown at F. The iron cores G G may be riveted onto the iron yoke Y or secured by machine screws. The yoke Y should have the same cross-sectional area



Hints on Making Electro-Magnets.

as the cores G, or even a greater area. Tapering the pole faces as shown increases the pull on the armature, as it raises the flux density at this point. Contributed by

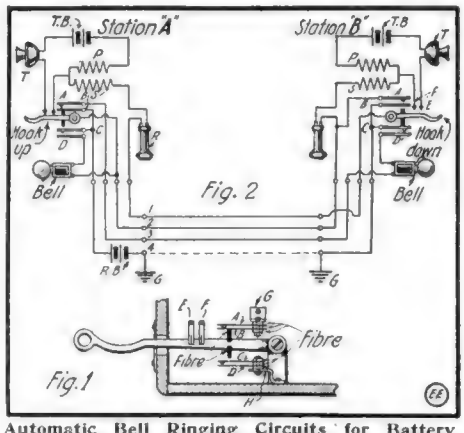
E. THOMPSON.

STUNT FOR BATTERY TELEPHONES.

Herewith is a handy time-saving stunt for those using ordinary battery telephones.

In Fig. 1 E and F are the regular talking contact springs, E going to the transmitter and F to the induction coil, P and S, see Fig. 2. G and H are brass arms, serving as supports for the springs, A, B, C and D. These springs are made of spring brass, and are about 1½ inches long, 3-16 inch wide and quite stiff (about No. 24 gauge). The springs, A and C, have a piece of platinum wire inserted at their ends, which make contact on two pieces of platinum foil on springs, B and D. The springs A, B, C and D are insulated from each other and from their supports by means of fiber washers between them, and the whole clamped together by a screw and nut, as shown. On top and bottom of the hook saw or file out two recesses and fit into them two pieces of fiber ⅜ inch square by ⅛ inch thick. These actuate the springs A, B, C and D. The hook spring, tending to push the hook up, is not shown for the sake of clearness.

Referring to Fig. 2 it will be seen that four wires are required for a full metallic system; but inasmuch as the No. 4 wire is used for ringing only, it may be substituted by the ground as shown, the dotted line in-



Automatic Bell Ringing Circuits for Battery Telephones.

dicating the No. 4 wire if used. By following out the circuits in Fig. 2 it will be evident that raising the receiver from the hook at station A, will ring up station B, which will continue to ring until B answers his telephone or A replaces his receiver on the hook. R B is the common ringing battery for the system. Wires 1 and 2 are used for talking and wires 2, 3 and 4 (or ground) for ringing. There are no push buttons or switches to operate in this improved system, and only three wires are really necessary.

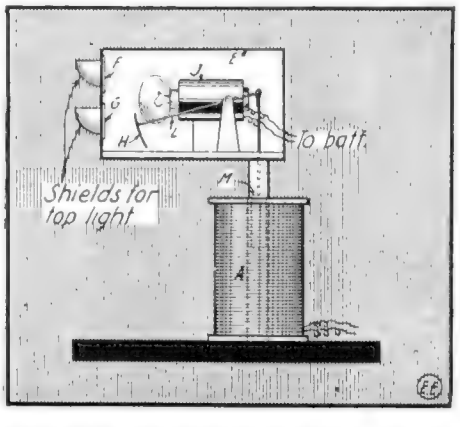
Contributed by

FRANK G. CASEY.

A MINIATURE ELECTRIC RAILWAY SIGNAL.

Those interested in small electric railways in miniature will probably like to construct a double lamp signal, electrically operated by a solenoid magnet, as the sketch here shows. It is very simply made and a single, low voltage battery lamp serves the purpose.

Referring to the sketch, A is a solenoid coil, corresponding to an ordinary bell magnet and inside of this a movable iron core M can slide up or down. This sliding iron plunger M is joined to a pivoted arm L. On the end of this arm is mounted a shutter H. Two small shields with

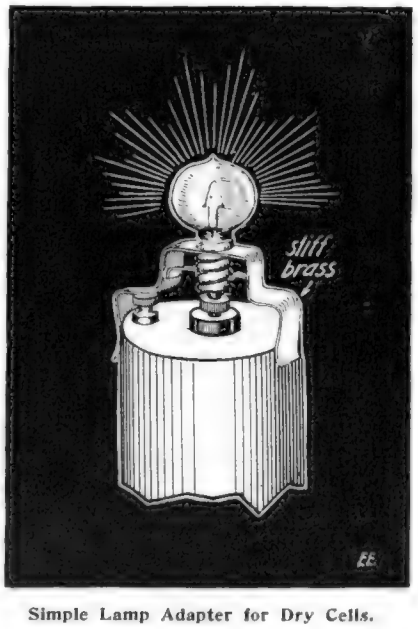


Two-Way Miniature Electric Railway Signal.

white and red glasses F and G are mounted in one end of a light-proof casing E. J is a minature lamp socket holding the small tungsten lamp, as observed. This lamp is supposed to be kept burning, while the miniature railway is in operation and the white and red or green and red signals, as desired, are shown alternately, by suitably arranged automatic or other switch contacts, to open and close the solenoid coil circuit. The solenoid may be wound with about 40 yards of No. 26 magnet wire or with a somewhat larger wire than this. Contributed by I. WITT.

A HANDY BATTERY LAMP MOUNT.

The following is the description of a handy and simple mount for lamps. Procure a sheet of springy brass and cut a strip about 5 inches long and 1 inch wide, but leave a hole in the center large enough to admit a miniature lamp adapter. This is to be placed in the hole and supported by two pieces of brass, bent and soldered, as clearly shown in the sketch. The brass (large) strip, of course, must also be bent exactly as shown in sketch. Then, lastly, screw a lamp into the adapter and the device is ready. Snap it on to a dry cell and it is ready for use, as shown. The battery cannot be short circuited, as the brass strip is in connection with the zinc when attached and the carbon of the battery individually in connection, with the base of the lamp just protruding a little so that carbon, screw and base of lamp touch. If the light is not wanted the lamp may be



Simple Lamp Adapter for Dry Cells.

slightly turned to the right, thus opening the circuit. If battery is run down the outfit can be quickly clasped to another in three seconds.

Contributed by

HENRY BOWEN.

QUICKLY MADE CONDENSERS.

When in need of a small condenser for receiving, one can be easily made as follows:

Procure a small memorandum or notebook (such as those given away to advertise medicine, etc.) and some tin-foil. Cut the tin-foil sheets a trifle smaller than the leaves of the book and insert a sheet of foil between each leaf until the desired number of sheets are obtained to give the proper capacity, allowing the ends to protrude alternately on each side for connections.

Should a permanent condenser be required, the book containing the foil may be soaked in hot paraffine wax and pressed with weights; then mount it in a case. But for temporary use a weight placed on the book is sufficient. Contributed by

FRANK HAVERLAN, JR.

"AND THE WORM CAN'T ESCAPE!"

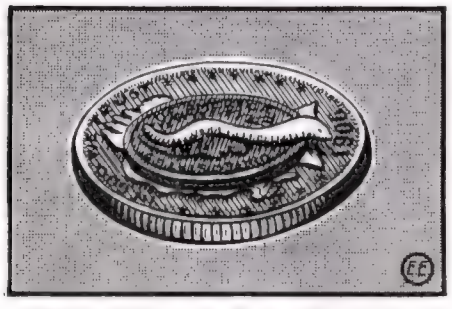
A rather peculiar experiment may be performed with the following articles, to wit: One worm (ordinary garden variety), one copper coin and one silver coin. The copper coin is placed on top of the silver coin, and it should be about 3/16 inch at least smaller all around than the silver piece. If now the worm is placed on top of the copper coin, it will be found that it cannot get off same, as every time he gets his damp body in contact with the two different coins it sets up an electro-motive force through the circuit so provided, which gives Mr. Worm, of course, an appreciable shock; so much so, in fact, that he prefers to stay on the top coin.

Contributed by G. HUGO.

[*What happens to such an experiment as this, in case the worm is kept on the top coin long enough to become thoroughly dry, the author of the experiment does not state.—Ed.*]

It will probably make the worm turn!

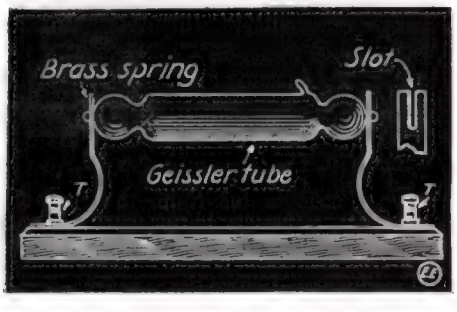
G. H.



The Worm Can't Get off the Coins.

A GEISSLER TUBE STAND.

Many experimenters have no doubt often wanted to know a simple way in which to mount Geissler tubes. Here is a way to mount it. Obtain a piece of wood, marble or glass. Take the brass parts from an old flashlight battery and bend them as seen in the sketch. Cut or file slots in both springs and the tube can then be snapped into place. The secondary spark coil leads



Geissler Tube Stand.

connect to the two binding posts, TT.

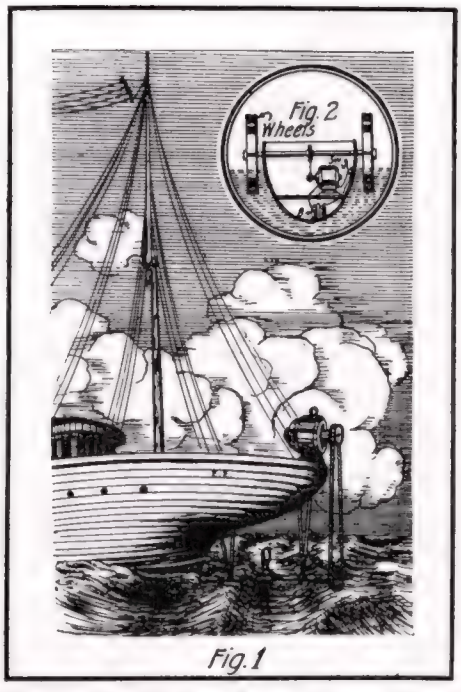
Contributed by LLOYD STRATTON.

ORGANIZE WIRELESS SOCIETY AT ATLANTA, GA.

A wireless society has been organized at Atlanta, Ga., to advance the interests of wireless amateurs and is known as the Atlanta Radio Club. Communications from amateurs within 100 miles from Atlanta are solicited by the club.

Amateur operators, or those wishing to become such, are requested to interchange ideas with the members of this society. All correspondence should be addressed to M. A. Herzog, secretary, 16 Faith street, Atlanta, Ga.

A MOTOR ATTACHMENT FOR BOATS.



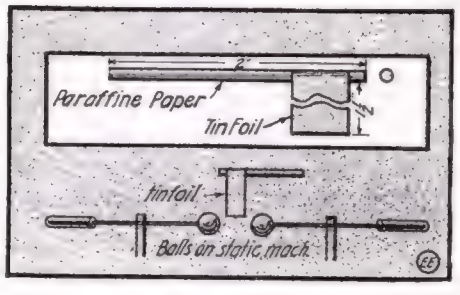
Attaching Small Battery Motors to Model Boats.

Toy boats, such as miniature yachts, sailboats, etc., can be electrically propelled by means of a motor acting as the chief propelling agent. Sketch at Fig. 1 shows how motor is fastened on the end of boat, and by means of its shaft and belting is propelling the vessel by turning the shaft of the propeller, fastened and supported by two wire supporters "A." For battery power a 3-volt Radio Nitrogen Battery is the choice, instead of loading the vessel with less powerful one delivering only 1½ volts or so. Two of these powerful cells will operate the motor at a terrific speed and will rapidly propel the vessel it is attached to. Paddle wheels can also be used. Two should properly be employed, and the diagram at Fig. 2 shows the arrangement for this method, if preferred. The cells of battery can be placed in the lower part of the vessel and can be controlled by a switch conveniently located. Contributed by

WM. WARNECKE, JR.

A STATIC EXPERIMENT.

Here is an experiment for static machines. Take a piece of paraffine paper about 2 inches long and roll it. On this paste a piece of tinfoil and let it hang down about 1½ inches from the paper. Now place the paper in left hand and hold over the balls on the machine. Start the static



Static Machine Experiment.

machine and then let go and watch the tinfoil fly back and forth very rapidly.

Contributed by A. J. BOLDIZAR.

HOW TO FROST GLASS.

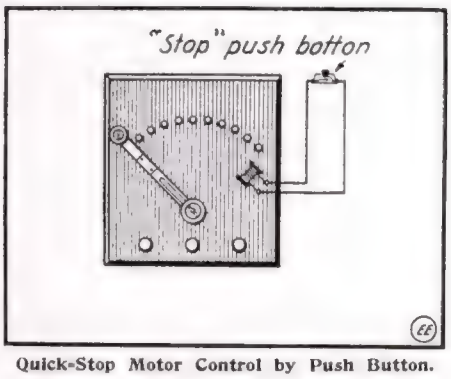
By proper chemical treatment glass electric bulbs will have the same appearance and do the same work as glass subjected to grinding.

In 2 ounces of ether dissolve 90 grains of gum sardarac and 20 grains of gum mastic. One ounce of fresh benzole is added later. The solution should be poured quickly and evenly over the surface to be frosted. Contributed by

W. WESTON.

QUICK STOP FOR ELECTRIC MOTORS.

One of the simplest ways in which to stop an electric motor employing the usual no-voltage release type starting box, is to connect a push button across the electromagnet on the face of the box. When this push button is depressed it short-circuits the magnet coil and the arm of the starting box is quickly released, cutting off the power to the motor.

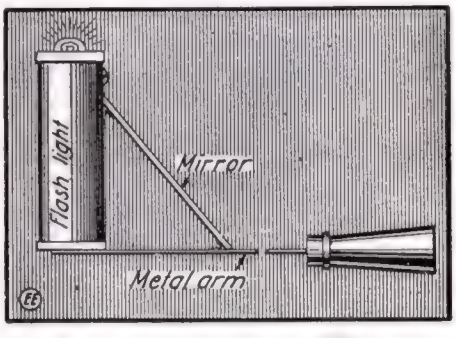


Quick-Stop Motor Control by Push Button.

This principle is used to a great extent in the various styles of push button type electro-magnetic controllers on the market.

A "WALLOSCOPE" FOR ELECTRICIANS.

The drawing herewith shows what I have termned a "Walloscope;" it will be found of great help to electrical contractors, wiremen, machinists, or in fact anyone



Wall Inspecting Lamp for Electricians and Others.

who in the course of his work finds it necessary to employ a special instrument to look into places which cannot be seen otherwise. The following device will be found very handy in such a case:

It consists of a regular small size pocket flashlight fastened on the end of a handle, which also carries a mirror, in which to view corners with, etc. Contributed by

CARL S. DRESS.

AMATEUR WIRELESS STATION NEARLY READY.

The boys of Mt. Sterling, Ill., have their wireless station about ready and expect to be able to receive messages in a few days. When this is in running order, the weather reports sent out by the Government from the Illiopolis wireless station will be picked up by them.

WRINKLES—RECIPES—FORMULAS

Edited by S. GERNSBACK

Under this heading we will publish every month useful information in Mechanics, Electricity and Chemistry. We shall be pleased, of course, to have our readers send us any recipes, formulas, wrinkles, new ideas, etc., useful to the experimenter, which will be duly paid for, upon publication, if acceptable.

EXPERIMENTERS APHORISMS.

In the following, we wish to give to the Experimenter some hints as to the use of the different ingredients and how to work them:

(1) Always bear in mind that exact working of a formula requires ACCURACY, CLEANLINESS, PATIENCE, and SKILL.

(2) Know what you are about, before you start to experiment.

(3) "THE HISTORY OF FAILURES IS THE HISTORY OF SUCCESS" goes an old adage, and it applies well to the experimenter.

(4) Many times impure, wrong or deteriorated raw materials, spell FAILURE instead of SUCCESS.

(5) A great many of the chemicals and ingredients required, cannot be obtained from drug stores; buy them at a reputable supply house.

(6) BEFORE CONDEMNING A FORMULA, be sure the fault does not lie with the manner of handling it, or the purity of the ingredients.

(7) Be sure to mix the materials comprising a certain formula in the proper sequence.

(8) When starting to prepare a mixture, especially one containing liquids, ask yourself: "IS THE SPECIFIC GRAVITY CORRECT, AS INDICATED BY A HYDROMETER? IS THE TEMPERATURE RIGHT? IS THE QUANTITY OR WEIGHT RIGHT?

(9) Acids and water, when mixed, should be manipulated in the proper manner, i. e., THE ACID SHOULD BE POURED INTO THE WATER, and not vice versa, as the solution is liable to be forcibly ejected from the containing vessel and into the mixer's face.

(10) For any kind of SYSTEMATIC WORK, a floating THERMOMETER and HYDROMETER, as well as measuring glasses and scales, should always be provided, as GUESSWORK is EXPENSIVE, and SOMETIMES FATAL.

(11) Put labels on ALL bottles, boxes and packages with FULL INSCRIPTION as to their contents, it will avoid troubles and mistakes.

(12) Remember that a beginner cannot expect to make articles AT FIRST, which will compare with regular manufactured products.

FORMULA 13.

Welding.

Welding Composition.—Dissolve in water 30 parts of *Borax,* 4 parts of *Sal Ammoniac,* 4 parts of *Cyanide of Potash.* Evaporate the water at a low temperature.

Welding Flux.—Pulverize the following ingredients: 2 oz. of *Copperas,* 1 oz. of *Saltpeter,* 6 oz. of *Salt,* 1 oz. of *Oxide of Manganese,* 1 oz. of *Cyanide of Potash.* Mix together with 3 lbs. of good *Welding Sand.*

Welding Powders.—Calcine and pulverize together 50 parts of *Iron Filings,* 5 parts of *Sal Ammoniac,* 3 parts of *Borax,* 2½ parts of *Copaiba Balsam.*

To Weld Cast Iron.—Take of good, clear *White Sand,* 3 parts; *Refined Solton,* 1 part; *Fosterine,* 1 part; *Rock Salt,* 1 part; mix all together. Take the two pieces of cast iron, heat them in a moderate charcoal fire, occasionally taking them out while heating and dipping them into the composition until they are of a proper heat to weld, then at once lay them on the anvil and gently hammer them together.

To Weld Cast Iron.—The best way of welding cast iron is to take it at a very intense heat, closely approaching the melting point. In this state it will be found sufficiently malleable to stand welding by the hammer.

Composition Used to Weld Cast Steel.—10 parts *Borax,* 1 part *Sal Ammoniac.* Grind or pound them thoroughly together, then fuse them in a metal pot over a clear fire, taking care to continue the heat until all spume has disappeared from the surface. When the liquid appears clear the composition is ready to be poured out to cool and concrete; afterward being ground to a fine powder, it is ready for use. To use this composition the steel to be welded is raised to a heat which may be expressed as "bright yellow." It is then dipped among the welding powder and again placed in the fire until it attains the same degree of heat as before. It is then ready to be placed under the hammer.

Composition for Welding Cast Steel.—Pulverize borax, any quantity, and slightly color it with dragon's blood. Heat the steel red hot, shake the borax over it; place it again in the fire till the borax smokes on the steel, which will be much below the ordinary welding heat, and then hammer it.

German Welding Powder.—4 parts *Iron Turnings,* 3 parts *Borax,* 2 parts *Borate of Iron,* 1 part *Water.*

Welding a Small Piece of Iron Upon a Large One, with Only a Light Heat.—It is often desirable to weld a small bit of iron upon a large bar, when the large piece must be heated equally hot as the small one. To save this take *Borax,* 1 lb., *Red Oxide of Iron,* 1 to 2 oz. Melt them together in a crucible, and when cold pulverize it and keep the powder dry for use. When you want to perform the operation, just bring the large piece to a white heat, having a good welding heat upon the small slip; take the large one from the fire and sprinkle some of the powder upon the place, and bring the other upon it, applying the hammer smartly, and the weld will be as good as could be made with the greater heat without the powder.

Belgian Welding Powder.—1,000 parts *Iron Filings,* 500 parts *Borax,* 50 parts *Balsam of Copaiba or other resinous oil,* 75 parts *Sal Ammoniac.* Mix all well together, heat and pulverize completely. The surfaces to be welded are powdered with the composition and then brought to a cherry-red heat, at which the powder melts, when the portions to be united are taken from the fire and joined. If the pieces to be welded are too large to be both introduced into the forge, one can be first heated with the welding powder to a cherry-red heat and the other afterward to a white heat, after which the welding may be effected.

S. G.

FORMULAE FOR INVISIBLE INKS AND SILVER PLATING.

No. 1.—20 parts water, 1 part sulphuric acid. Add the acid to the water and not the water to the acid. Unless care is taken that this is done, the heat developed by the dissociation of the acid may break the vessel. Use with a clean steel pen, and when writing is dried it will become invisible, unless the pen has scratched the surface. To read, hold the paper for a moment near a red-hot stove or before a gas flame.

No. 2.—1 oz. citrate of potash, 5 oz. water. Make a complete solution and use same as No. 1.

Sympathetic Ink.

Dissolve chloride or nitrate of cobalt in water. When warmed slightly before a fire the writing will show; on exposure to moist air it will disappear.

Silver-plating Fluid.

One oz. silver nitrate, 12 oz. rain water. Dissolve and add 2 oz. of potassium cyanide. (The latter should be carefully handled, as it is poisonous.) Clean the article thoroughly and apply the fluid by rubbing. The fluid may be used on detector parts, but as the deposited film of silver is not very substantial it would not do for articles which are to be continually carried in the pocket, etc. Contributed by

A. D. R. FRASER.

Why not subscribe to-day? Don't miss the many good articles in store for you.

REGARDING WOOD STAINS, ACIDS AND INVISIBLE INKS.

I wish to call your attention to the invisible ink recipes on page 100 of the July, 1915, issue by Mr. K. K. Knaell, particularly to No. 3. I have used with very good success a formula composed of 50 grains of chloride of cobalt, 1 ounce of water and 10 minims of glycerine; the latter being added to give body to the writing fluid. I think if the formulas mentioned by Mr. Knaell had this addition the writing quality would be increased.

The Proper Use of Sulphuric Acid.

This article is written for the benefit of amateur electrical and wireless experimenters as well as those interested in chemistry, not familiar with the dangers which may arise if sulphuric acid is not properly used.

Sulphuric acid is chiefly used in electrical experiments in the construction of electrical batteries. It is commonly and commercially known as "sulphuric acid," but there are other names under which it is termed and sold, i. e., "hydrogen sulphate," "hydric sulphate," "oil of vitriol," etc.

It is a thick, heavy, oily, sour and corrosive liquid, and in its pure state is without odor or color. It boils at 338 degrees and freezes at about zero.

The fact has been repeatedly illustrated in experiments already performed that sulphuric acid has a very strong tendency to absorb water and form compounds with it, thereby causing great heat to be formed in this action, and attention is called to the necessity for caution in mixing the liquid.

ALWAYS POUR sulphuric acid IN SMALL QUANTITIES INTO the water while stirring the same VIGOROUSLY. It is also well to work with such chemicals as sulphuric acid, nitric acid, hydrochloric acid, etc., where a draught of air can be created to prevent the poisonous fumes from being inhaled into the lungs.

Wood Stains.

To stain ebony, mix: Solution A—Water, 10 ounces; sulphuric acid, 1 ounce. Brush on and allow to sink into the wood to be stained, and then hold close to a fire for a few minutes, in which time a rich black is produced.

Solution B—Strong solution of aniline in alcohol or French polish.

To Stain Walnut.—Potassium permanganate, 60 grains; water, 10 ounces. Used weaker it imitates oak.

To Stain Green.—Solution A—Verdigris, 4 ounces; vinegar, 40 ounces. Solution B—Indigo, 1 drachm; vinegar, 20 ounces. Boil each for 10 minutes. Mix according to tint. Average proportion: (A) 6 ounces: (B) 1 ounce. Contributed by

A. WILSDON.

WIRELESS PLANT BASIS OF SUIT.

Vice-Chancellor Stevens, in an opinion filed in the Trenton, N. J., Court of Chancery Aug. 2 last, denied the application of a German corporation for the postponement of the hearing and determining of a suit brought in the Court of Chancery of New Jersey by a French corporation to compel the German concern to carry out an alleged contract to dispose of its wireless telegraph station at Tuckerton, N. J., to the French corporation.

The Germany company in its answer to the suit denied knowledge of the contract and asked that a hearing and determining of the case be deferred until after the close of the present war.

The name of the German company is the Hoch Frequenz-Maschinen Aktien-Gesellschaft für Drahtlose Telegraphie of Berlin. The French corporation is the Compagnie Universelle de Télégraphie et de Téléphon sans fil, with offices in Paris.

AMONG THE AMATEURS

AMATEUR RADIO STATION CONTEST.

Monthly Prize, $3.00.

This month's prize winner.

PAUL SHNEY'S AMATEUR STATION.

The following is a description of my radio receiving station:

Receiving—A home-made duplex loading coil with primary slider and secondary switch with seven points, a loose coupler, a variable and fixed condenser. For convenience in quickly changing from long to short wave length, and vice versa, the switch at the left of the loose coupler is used to short circuit either the primary of the loader or the series condenser. A 3-point detector switch is used to connect at will a Radioson detector, a silicon or a galena detector. The operative detector is connected in series with a "junior" fixed condenser. The "junior" condenser is bridged by two 1,000-ohm receivers in

Paul Shney Enjoys to the Full His Excellent Wireless Set.

series, while the ½ M. F. condenser is bridged by two watch case receivers in parallel. Some wires connected to the other leads enable four people to hear at once, and are also used as a buzzer telegraph line for experimental purposes. The switches and rheostat at the bottom of the board are used to control these circuits, as well as the coherer and polarized relay for audible reception of signals.

My aerial is 125 feet long and spaced 2 feet 8 inches apart. Iron pipe spreaders 11 feet long are supported at the upper end to the roof of a three-story hospital. The maximum wave length of primary and secondary are each about 5,000 meters. Weather conditions prevent me from hearing WSL and NAA occasionally.

PAUL F. SHNEY.

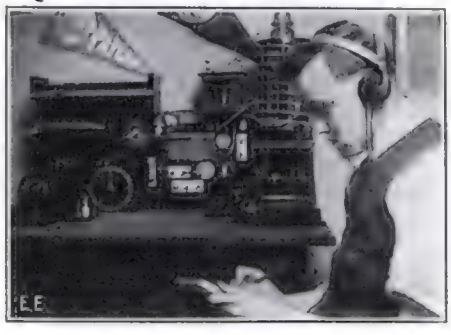
Pittsburgh, Pa.

The United States navy will establish a wireless station on Cape Cod especially equipped to guide vessels along the Atlantic coast in time of fog.

Within a few months wireless messages have been sent from a station in this country to Paris. They are sent direct and not relayed from ships.

A SUCCESSFUL RADIO STATION.

Herewith will be found a photograph of my radio laboratory which I wish to enter in your contest. As you will notice, the set is practically all home-made, but I get excellent results. I am now experimenting with a one-wire antenna 150 feet long and 65 feet high at one end and 80 feet at the other.



Harold Mason at His Radio Set.

For sending I use a 2-inch spark coil, operated on dry cells, helix, adjustable plate condenser, "Electro" vertical gap inclosed in cabinet and key. I have a small medical coil with which I can send short distances. I have also a complete buzzer test in circuit.

For receiving I have one large single slide tuner, one loading coil, receiving transformer, pancake tuner with 25 taps, one "Electro" fixed condenser, one mineral detector for galena, silicon or iron pyrites and one head set of 1,000-ohm receivers.

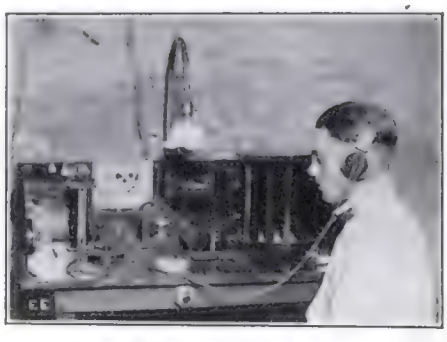
I hereby wish to state that I agree with other amateurs that galena is the best of all minerals in use.

Paterson, N. J. HAROLD MASON.

HAROLD BENNETT'S WIRELESS PLANT.

I give you herewith photo of my wireless set, which I should like to appear in your magazine. Starting from the left will be observed my receiving set, which consists of one loading coil, variable condenser, fixed condenser, a galena detector, tuning coil and a pair of 2,000-ohm 'phones. In my sending outfit I use a ¼-inch Bulldog spark coil, two glass plate condensers (home-made), one large helix, spark gap, key and double throw switch. The latter articles are all home-made.

My aerial is built on top of a school building and I can receive up to 1,000 miles and send about four. I can hear (I. W.



Harold Bennett's Radio Station.

Co.) Illinois Watch Co. very clearly.

HAROLD BENNETT.

Clarinda, Iowa.

DONALD HOFFMAN'S WIRELESS OUTFIT.

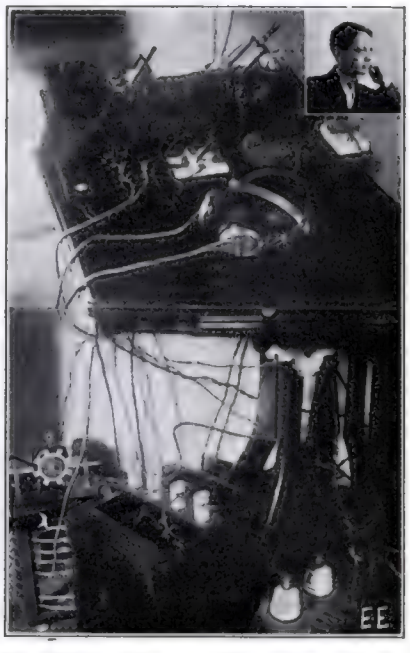
Your last few issues of the *Electrical Experimenter* have made it my favorite electrical magazine. Perhaps its readers will be interested in a brief description of my wireless station.

Sending set: Packard ½ K. W. transformer, home-made glass plate condenser connected series-parallel, rotary spark gap, home-made oscillation transformer, key, switches and rheostat.

Receiving set: Selective coupler, Blitzen loading coil, rotary variable condenser across secondary circuit, Brandes' 2,000-ohm receivers, Crystaloi detector and buzzer test, galena detector and small fixed condenser in shunt with receivers.

I have two aerials of copper-clad wire, both well insulated and provided with proper lightning switches and ground wires. The small aerial is "L" type with four wires, 57 feet long and 30 feet high and is used for sending. The large one is of the "T" type with two wires, 210 feet long; both aerials used for receiving.

I also have wire connection to another



The Efficient Radio Outfit of Donald Hoffman.

boy's house, two blocks away, over which we conduct numerous experiments in wireless, telephony, telegraphy and other forms of communication.

The local amateur and commercial stations all come in fine, as do Arlington, Sayville, Detroit, Cleveland, Canton, Key West and others. Extension receivers and buzzer test control in my bedroom enable me to listen in at any time I care to.

The outfit is mostly all on or under a table, easily accessible, and in as small a space as possible. All wiring and other work of this nature was done by myself, including the electric-light wiring, which was necessary in order to use the transformer outfit. I keep wireless maps, photos and wiring diagrams posted on the wall for instant reference by myself or visitors. I have a Government license and an official call, "8 A.D.U."

DONALD HOFFMAN.

Akron, O.

"THE AMATEUR SCIENTISTS."

A new wireless association known as "The Amateur Scientists" was organized a short time ago and constitutes the following members: J. G. Dashafsky, W. Wernick, O. Dubs, E. Duskis, H. Fienberg, A. Feldman and S. Bosowitz.

The purport of this society is to make the acquaintance of young scientists and people scientifically inclined. All communications should be addressed to Ephraim Duskis, press agent, 1423 St. Marks Ave., Brooklyn, N. Y.

OSTROPOL'S RADIO STATION.

The accompanying photograph portrays my radio receiving (portable) station, which I constructed myself and from which very successful results are obtained.

This set is composed of a double slide tuner, 20 inches long and 4 inches in diameter, wound with No. 20 enameled copper wire, a variable condenser, two crystal detectors, a test buzzer and two 3,000-ohm head 'phones. This outfit is mounted in a highly polished oak cabinet 22 inches long, 11 inches wide and 6 inches deep, which opens by means of folding doors. Four binding posts, two on each side of cabinet, enable me to operate the set without opening the doors.

I wish to say that I have gained most

Michael Ostropol and Portable Radio Receiving Set, Which Has Done Very Fine Work.

of my ideas from the *Electrical Experimenter*, of which I am a constant reader.

MICHAEL OSTROPOL.

Chicago, Ill.

JEANNETTE, PA., BOY WIRELESS OPERATOR ON THE TEXAS.

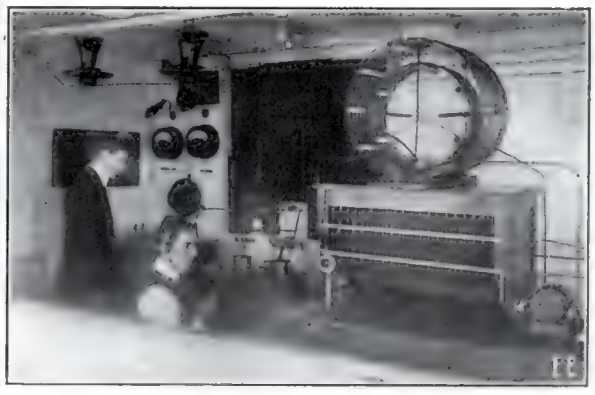
Relatives have received word from Simon J. Murphy, a popular young man of this town, telling of his successful appointment as wireless operator on the United States dreadnaught "Texas," and of the aquatic maneouvers of that huge fighting vessel of Uncle Sam's navy in Gulf waters.

"We are en route South for maneouvers and target practice; thence to Mexico, it is believed. Everything looks very encouraging to me, and my chances to become a 'radio gunner,' as it is termed, are very good," he said.

Young Murphy received the appointment recently and is in full charge of the "wireless room." He is a graduate of the United States navy electrical school.

A SUCCESSFUL WIRELESS TELEPHONE AND TELEGRAPH STATION.

The accompanying photograph shows Earl Hanson and Hadys Hancock operating the private wireless telephone and telegraph station on Venice pier, California.



Wireless Telephone and Telegraph Station of Earl Hanson and Hadys Hancock.

On the table at the left and under the switchboard is shown a mahogany case containing the wireless telephone apparatus. Among the various systems tried the 60-cycle arc gives all around results and holds up under long tests. It may be well to say here that much value has been derived from your articles on wireless telephony appearing in the *Electrical Experimenter.*

Above the switchboard can be seen the large high-tension insulators connecting the aerial lead to the transmitting set. This consists of a 5-kw. closed core transformer, but to conform with the radio law only 1 K.W. is used. A large glass plate condenser and an inductance, together with a high-speed rotary gap, giving a high note, easily read through interference, completes the set. The connections throughout the station are of large brass and copper tubing, giving the minimum high frequency resistance.

In the center of the photo, just below the aerial switch, is depicted the latest type receiving set. The aerial, made of E. I. Co. stranded "Antenium" phosphor-bronze cable and situated on the pier, is 300 feet long and 100 feet high. With the ocean for a ground, surprising receiving distances are accomplished. Nature also helps here, for the Pacific coast is not so heavily charged with the static that is encountered on the Atlantic seaboard.

EARL C. HANSON.

Los Angeles, Cal.

RADIO EQUIPMENT OF HUBERT M'ILVAINE.

Herewith is a photo and description of

Complete Radio Set of Mr. M'Ilvaine Includes Amplifier.

my wireless station. The sending outfit consists of a 1½-inch spark coil, home-made condenser of photo negatives and tinfoil, helix, spark gap, sending key and 6-volt storage battery.

For receiving I use a pair of 2,000 ohms E. I. Co. 'phones, galena, silicon, perikon and electrolytic detector, small fixed condenser and a two-slide tuner. I ground my set to a well-pump and derive very efficient results.

With a two-wire 300-foot aerial I have many times heard N. Z. G. (Colon). I can easily receive Arlington (N. A. A.) N. A. R. and 9ZS at mid-day. I find the E. I. Co. galena the most sensitive detector I have ever tried when connected up in the proper way. My wireless outfit is situated on a table in a room, but is portable and was out of doors, as the photo shows.

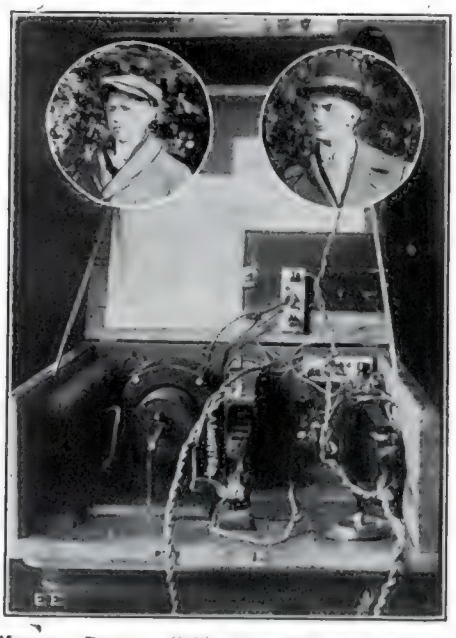
HUBERT M'ILVAINE.

Milroy, Ind.

C. D. PAPPAS AND C. H. RICH'S WIRELESS OUTFIT.

Herewith submitted are three photographs; one of our wireless set and the other of myself and Clinton H. Rich, which I wish to enter in your radio station contest.

Our receiving set consists of a loose coupler, three home-made plate condensers, one large galena detector, one ten-cent galena detector, two 1,000-ohm receivers,



Messrs. Pappas (left) and Rich, and Their Portable Wireless Set.

one fixed condenser, three home-made loading coils, etc. Our receiving range is 1,200 to 1,500 miles with an aerial 40 feet high and 60 feet long. It consists of four wires; the spreaders being 8 feet long. We can tune up to 2,000 meters.

CHRISTOS D. PAPPAS.
CLINTON H. RICH.

Haverhill, Mass.

RADIO CLUBS ATTENTION!

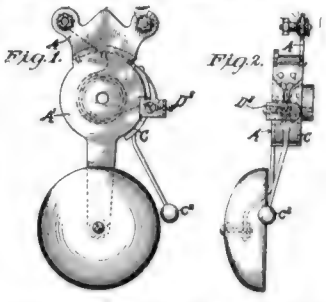
We are always pleased to hear from young Edisons and Radio Clubs. Send a write-up of your Club with photos of members and apparatus to-day to: Editor "Amateur Gossip" Section, The Electrical Experimenter, 233 Fulton St., New York City.

LATEST PATENTS

Electric Alarm Bell.

(No. 1,141,187; issued to Gustav A. Huber.)

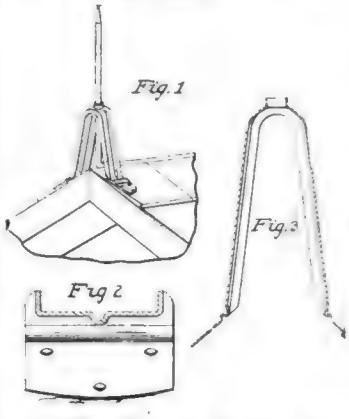
Differing from the usual forms of electric alarm bell construction, this



patentee arranges his bell very simply with a single magnet coil and the iron cheeks A and A^1 of the magnet bobbin attract the vibrating iron armature C, carrying the gong striker C^2. The usual vibrator contact screw D^3 is placed outside of the bell, but the general design is indeed rugged and simplified.

Lightning Rod Points.

(No. 1,140,582; issued to Thomas W. Dodd.)

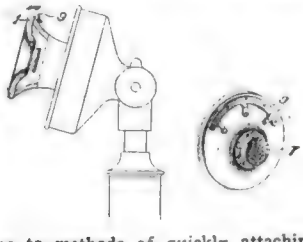


Simplified design for lightning rod points and particularly in rigid bracket supports for same, such as used on pitch-roofed houses. The device is seen in the illustration and the bracket is made from a specially grooved stamping to give maximum strength.

Sanitary Shield for Telephones.

(No. 1,142,600; issued to Russell H. Maxwell.)

A detachable sanitary shield, which may be carried by everyone, is provided for in this patent, and simple means are specified therein



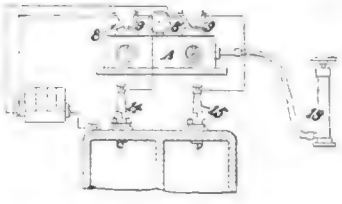
as to methods of quickly attaching and detaching same from telephone transmitters and receivers. Spring clips 9 and 12 enable the user to perform the attachment quickly. The transmitter shield 1 also carries a perforated disc 7, etc.

Auto-Engine Sparking Indicator.

(No. 1,140,816; issued to Claud E. Harlan.)

The inventor of this device intends it for assimilating gasoline engine cylinder conditions in a specially arranged and distinct tank "A." Air pressure, as from a small pump 19, is forced into the chamber "A" and if the spark is all right between the spark plug 8 and 9 terminals under such air compression (which is carried to the same value as that in the engine cylinder), then the ignition system is supposed to be all right. The gauge on top of the chamber measures the air pressure within.

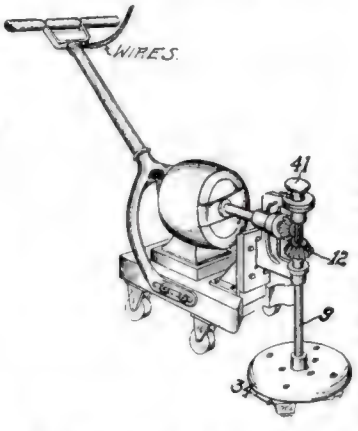
It is difficult to see how this device will show up a short-circuited or befouled spark plug in the cylinder at 14 or 15, particularly as the inventor states specifically that his invention enables engine testers to check up the ignition exactly without removing engine spark plugs 14 or 15.



Electrically-Driven Floor Polisher.

(No. 1,141,287; issued to William B. Thayer.)

A handy form of electric motor-driven floor polisher having several unique adjustable features about it. The polisher 34, having special polishing shoes attached to it, can be raised from the floor and held in that position by a small button 41 and a trip finger on the side of same. The driving pinion 12 is feathered on the vertical shaft 9 of



the polisher head to allow of its rising up and down as explained.

Electric Percussion Hammer.

(No. 1,140,447; issued to Achilles de Khotinsky.)

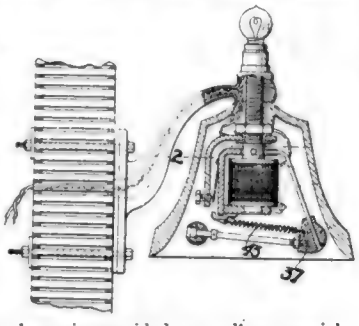
The inventor of this improved electrical percussion hammer for riveting and other work has ingeniously arranged a switching drum 33, controlled by a connecting rod, arranged to be actuated or moved back and forth co-axially by the reciprocating electro-magnetic action of an iron plunger 10. The magnet coils are specially arranged to give the greatest pull on the plunger and also they are made to

act on the plunger in its return stroke, so that it is magnetically cushioned. A really good invention, it seems.

Electric Signal for Automobiles.

(No. 1,140,492; issued to Harold B. Anderson.)

Electrical signaling device for autos, intended to be attached to the radiator of same. Electric signal

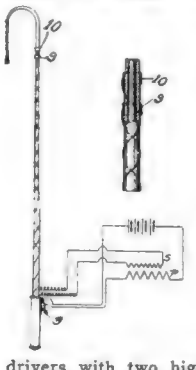


lamp is provided as well as special compact form of electro-magnetically operated bell. A single magnet coil attracts an iron armature 2 and this raises the striking hammer 37 in the bell. A spiral spring 43 helps to return the striking hammer.

Electric Whip.

(No. 1,140,365; issued to Henry C. Dixon.)

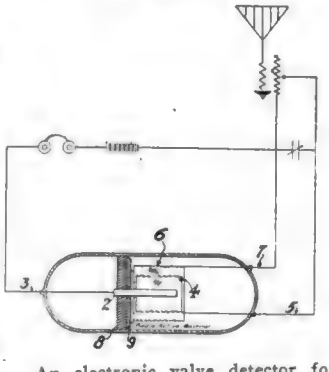
A cleverly arranged whip for



team drivers with two highly insulated electric wires wound spirally along the length of the whip, as shown, and terminating in two metal ferrules "9" and "10." A switch "3" on the handle of the whip controls the primary circuit of a small spark coil. Pressing the button causes a spark to jump from one metallic ferrule in contact with the animal's skin, and so on through the skin to the second metallic ferrule. It is pointed out by the patentee that this arrangement is preferable for team drivers, etc., to that of excessively applying a lash whip which cuts the skin.

Radio Valve Detector.

(No. 1,145,735; issued to Chester Drew Ainsworth.)

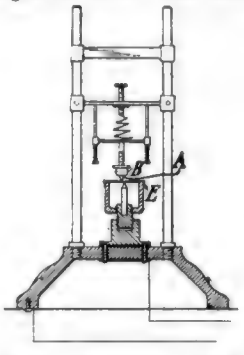


An electronic valve detector for wireless telegraphy, intended to utilize the electron radiations from some radio-active material, such as pitch-blende, etc. As drawing shows, the wireless tuning circuits are hooked up by means of wires, 3, 5, and 7, to three electrodes, 2, 4 and 6. An electron discharge of course is always taking place from the radio-active substances 9, suitably mounted on a disk 8. The incoming etheric waves cause variations in the electronic stream between the electrodes of the valve, similar to the action of the Audion detector. It seems doubtful whether this electron discharge will be strong enough for practical requirements.

New Zinc Compound Radio Detector.

(No. 1,145,658; issued to William E. Ashton and Austen M. Curtis; assignors to J. Odell Fowler.)

An improved wireless detector making use of more or less elaborate

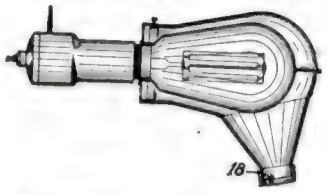


mechanical adjustment frame, as shown, and containing principally as a new feature, a metal cup B, in which is mounted a piece of special zinc compound A, consisting of zinc, oxygen, manganese in the form known as a species of red oxide of zinc. This mineral mass is in contact with a metallic plate or electrode disk E, having half its surface made conductive by facing it with platinum and the other half of it made an insulator by suitable enamel or other means. The detector can thus be cut in or out of circuit by simply turning the disk E.

Electric Egg Tester.

(No. 1,145,466; issued to Frederick W. Dobbel.)

Another form a electric egg tester,

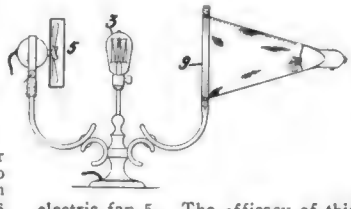


easily understood by examining the drawing. The inventor provides a metallic shell divided hemispherically, so as to be placed over an incandescent lamp by means of a suitable holder, as described. The egg to be inspected, is placed in the opening 18.

Electrical Insect Trap.

(No. 1,144,358; issued to Knut George Gyllstrom.)

As can be seen from the illustration, an electric lamp 3, suitably mounted, serves to attract the insects and they are then blown into a net or catch bag 9, by a strong draught of air propagated by the



electric fan 5. The efficacy of this device is self-evident and several other interesting features are covered in this clever patent.

(Copies of any patent above mentioned supplied at 10 cents each.)

Phoney Patents

Under this heading we will publish hereafter electrical or mechanical ideas which our clever inventors, for reasons best known to themselves, have as yet not patented. We furthermore announce the grand opening of the

PHONEY PATENT OFFIZZ

For the relief of all suffering daffy inventors in this country as well as the entire universe.

We will revolutionize the Patent business immmediately and OFFER YOU THREE DOLLARS ($3.00) FOR THE BEST PATENT. If you take your Phoney Patent to Washington, they charge you $20.00 for the initial fee and then you haven't a smell of the Patent yet. After they have allowed the Patent, you must pay another $20.00 as a final fee. That's $40.00!! WE PAY YOU $3.00 and grant you a Phoney Patent in the bargain, so you save $43.00!! When sending in your Phoney Patent application, be sure that it is as daffy as a lovesick bat. The daffier, the better. Simple sketches and a short description will help our staff of examiners to issue a Phoney Patent on your invention in a jiffy.

PHONEY PATENT OFFIZZ

PHONEY PATENT AFFIRMED, ALOYSIUS DODGASTIT

No. 71177.95 **ROCKAWAY MOTOR** **Patent Applied for 61½ B.C.**

Specifications of Phoney Patent
Hot Application Applied For

To those and whosoever cares:

I, Aloysius Dodgastit, of the City of Hades, in State of Exhaustion, have invented an apparatus to absorb, store, use and control in both its primary and its secondary form, electricity, the energy at present wasted by rocking women.

A woman will, by providing suitable means to a rocker, compress 500 cubic feet of air per hour and by actual experiment I have discovered that five times that amount of energy can be obtained from one unit by tying your mother-in-law in a chair and then kissing your neighbor's wife in front of her. (Not the neighbor's front, of course).

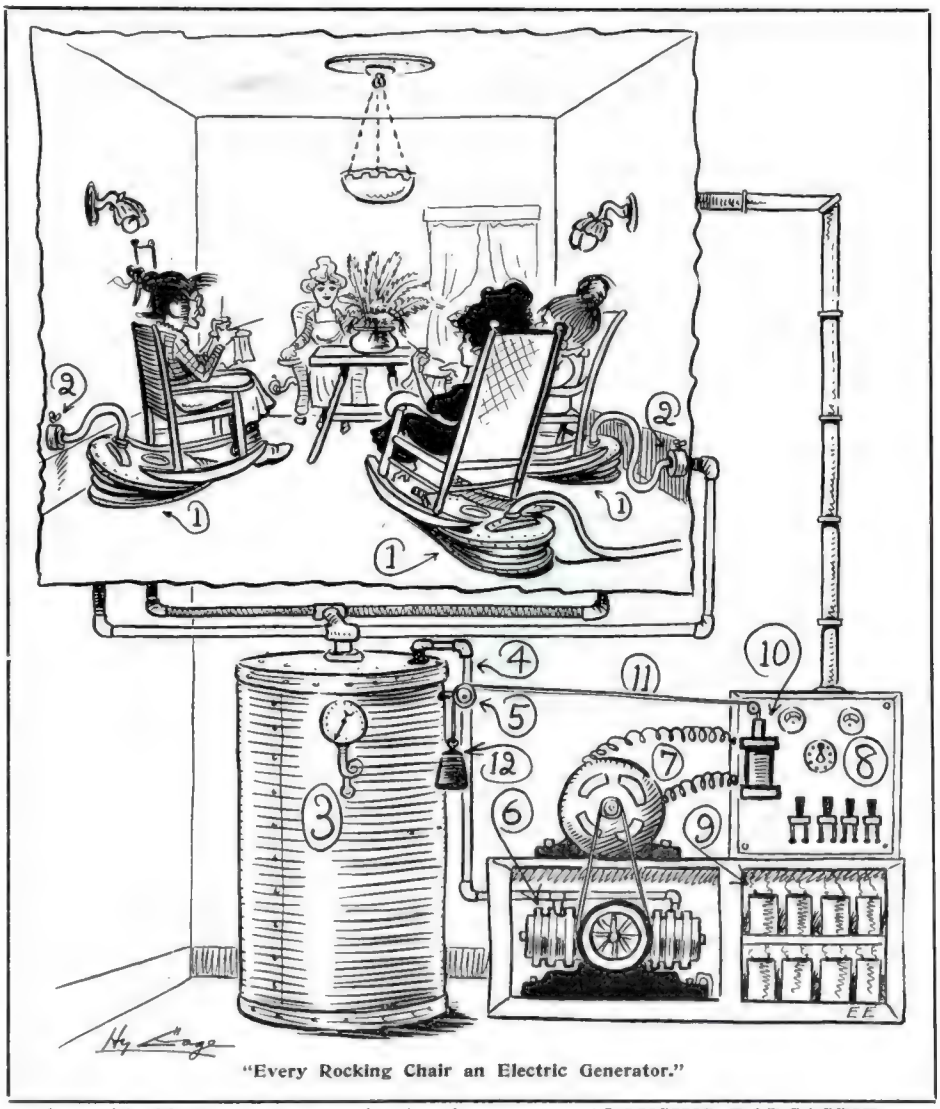
My invention consists first of a bellows placed under the rockers of the rocking chairs in the parlor (1). These chairs are connected by means of a flexible, reinforced tissue paper hose to the outlets fastened to the wall (2). Tissue paper is used to prevent the scratching and marring of the furniture. Flexible metal hose, covered with satin, can also be used if desired.

These pipes lead to a large double riveted and welded tank (3) from which the air passes through pipe (4) and valve (5) to a double acting opposed compressed air engine (6). A dynamo (7) is belted to the engine and the energy generated by the dynamo is controlled by switchboard (8) and conducted to storage cells (9). The surplus power of the batteries is used to light up the house, run ice cream freezers, vacuum cleaners, etc. On the switchboard is mounted a solenoid (10) which has its sliding core connected by means of a rope (11) to the valve (5). The action of this is as follows:

If no current is generated by the dynamo, the weight (12) will open the valve, allowing air to flow into the engine, this starts up the dynamo, which gradually shuts off the air, thereby acting as a governor, viz., if the engine runs too fast, the core in the solenoid will be attracted, the valve slightly closed and the engine will drop to its proper speed.

This makes the system automatic and all that is necessary to keep the batteries fully charged is to invite the sewing circle to your home one evening each week and let them rock.

I am patenting this to protect others from making money from the idea, so readers with this patent may go ahead and install one in your own home.



"Every Rocking Chair an Electric Generator."

In testimony whereof I have hereunto, for now and for all times, from the beginning of the world till this evening at 9¾ P. M., placed my seal this 20th day of today Anno Domino (sugar) 1991.

ALOYSIUS DODGASTIT,
By his Attorney:
THOMAS W. BENSON,
Philadelphia, Pa.

Witnesses:
O. Prooee,
G. Wotaboub,
O. Myeye.

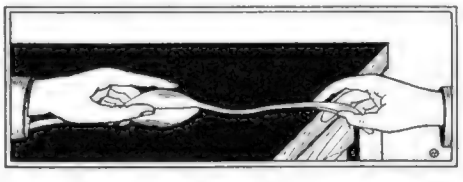
"SOME" SOUNDER.

I wanted to learn telegraphy but had no apparatus; so I invented one.

Here is the description: Take two dessert spoons as per sketch; that's all. Operate as shown. Just try it. It sounds like a real $10 sounder and the speed which you can attain is marvelous. It's all wrong, Baron Münchhausen: it's all wrong!!

Contributed by MULB EGROEG.

[Not having spoons around the office we could not try Mr. "Mulb's" scheme. If he will send us some of his spoons (solid silver, please), we will try our hand at it. —Editor.]



JAPAN-HONOLULU RADIO.

Wireless communication was successfully inaugurated recently between the new station at Funabashi, near Yokohama, and the Hawaiian Islands. The distance between Funabashi, where a new wireless station has been constructed, and Honolulu is about 3,380 miles.

QUESTION BOX

This department is for the sole benefit of the electrical experimenter. Questions will be answered here for the benefit of all, but only matter of sufficient interest will be published. Rules under which questions will be answered:

1. Only three questions can be submitted to be answered.
2. Only one side of sheet to be written on; matter must be typewritten or else written in ink, no penciled matter considered.
3. Sketches, diagrams, etc., must be on separate sheets. Questions addressed to this department cannot be answered by mail.

SOME INTERESTING RADIO QUESTIONS.

(305.) R. N. Turner, Fort Smith, Ark., sends us some uncommon questions below which the editor of this column thinks will be sufficiently interesting to warrant their publication, although usually three questions are the limit. We answer herewith some of your queries:

A. 1. A two-slide tuning coil is superior to a single slide tuning coil in wireless receiving circuits, due to the fact that the coil used in this way operates as an autotransformer, or, in other words, this single coil must do the work of a regular transformer, having two coils; the single winding acting both as primary and secondary. Hence it is evident that if the primary and secondary are to be adjustable independently, as they should be, of course, that it is impossible with a single slide coil to obtain independent adjustment of secondary and primary, but that both secondary and primary circuits, so to speak, must be adjusted in one operation with a single slide. Of course, this gives a very narrow latitude to the adjustment possible. With two slides it is evident that a regular loose coupler action can be approximately duplicated, as the diagram "A" shows.

A. 2. It is an indisputable fact, speaking generally, that a tuning coil or autotransformer is the most efficient type of transformer possible to build. This covers such

Diagrams for Query No. 305.

points as strength of signals received, etc. However, in radio receiving circuits there is often so much static and interference to be eliminated that it has been found that, all things considered, a loose coupled transformer with a distinct primary and secondary winding gives the best all-around results, as the selectivity and tuning effectiveness of such an arrangement is of far greater latitude than that possible with a single coil, the sections of which are all metallically interconnected or in one common circuit.

A. 3. Regarding aerials it seems to be a standard practise, both for commercial and experimental purposes to-day, to make use of a plain straightaway type of antenna. This calls for cross-connected strands at the free end of the aerial flat top and at the lead end of flat top. A lead wire is brought down from each strand and joined to a single, heavy, stranded cable preferably.

A. 4. With regard to the connection of the telephone receivers across the detector or across the fixed "blocking" condenser in the radio receiving hook-up you show this is a matter of minor importance, it seems, from our experience and that of others. Both arrangements are used practically indiscriminately, but for a mathematical and quantitative discussion on this matter we refer you to an excellent article which appeared in the February, 1915, issue of this journal, copy of which you can procure from the publishers at the regular price.

A. 5. With reference to connecting the condenser in a wireless transmitting set either across the secondary of a high voltage transformer or in series with the closed oscillatory circuit, as diagrams "B" and "C" show, this seems to make very little difference in most cases and both methods have been used indiscriminately on commercial wireless installations for many years on board ship, etc., by several of the foremost commercial radio companies to our correct knowledge.

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A. 6. Relative to the increase in strength of received signals caused by a person touching some metallic part of the aerial or by duplicating this condition by means of connecting a large coil of wire of one lead to the aerial we think that this undoubtedly is due to the increased capacity effect created; and, of course, the greater the capacity of an aerial in micro-farads, the greater its wireless activity.

A. 7. Concerning the long 740-foot aerial composed of one conductor acting better than a multiple wire, four conductor, 185-foot aerial for the wireless receiving of long wave lengths, etc., this is due fundamentally to the fact, as proven in a number of cases on record, that a small aerial when "boosted" by loading coils or condensers, etc., will not act to the utmost efficiency in receiving long wave lengths, which have a value greater than about three or four times the natural period of the antenna in question. Hence you will see that a 740-foot aerial wire will, on this hypothesis, receive 2,500-meter wave length much more efficiently in every way than would be possible with a smaller aerial of the multiple wire type.

This principle has been rigidly followed in all of the latest radio engineering developments, including the design of the large Marconi transatlantic station located at New Brunswick, N. J. These stations use tremendous wave lengths of from 12,000 to 15,000 meters value and the aerials conjointly are also very long, being in the neighborhood of one mile in length, following the principle above mentioned.

A. 8. Regarding the mineral "Cerusite" as near as we know this is similar to crystallized galena, or at least samples which we have tested appear to be nothing else. We have found regular cubic formation galena, as commonly used, to be superior to this so-called "Cerusite." Crystal detectors have been used in receiving transatlantic messages commercially, but nowadays some form of vacuum tube amplifier is most generally made use of.

RADIO QUERIES.

(306.) Harold C. Sever, Pleasant Plains, Ill., asks several wireless questions.

A. 1. The aerial arrangement you show should prove satisfactory indeed for wireless receiving, etc. The metal gutters should not have any appreciable effect on your aerial. By "dead ends" on loose couplers is meant the idle turns of the coils not in use when a certain signal is being received. They, of course, produce a large distributed capacity detrimental to the best operation of the set.

You should try some new peroxide of lead in your detector of that type, as these tablets vary a great deal in their sensitivity.

You are correct in assuming that a carrying capacity of 2,000 amperes per square inch of cross-sectional area for copper is common.

The wave length value of the helix turns in use in the wireless transmitting circuit must be added to the aerial wave length proper.

WAVEMETER CALIBRATION.

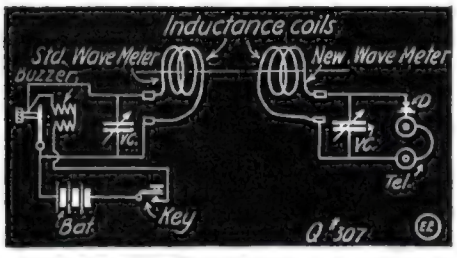
(307.) Warren S. Terriberry, New Bedford, Mass., wants to know how to calibrate a new wave meter from a standardized or master instrument of that type.

A. 1. In calibrating one wave meter by means of another wave meter, which is already calibrated, the general method is to make use of an exciting buzzer, shunted across the oscillatory circuit of the standardized wave meter, as the diagram herewith shows.

The wave meter to be calibrated is then placed sufficiently close to the inductance coil of the buzzer excited standard wave meter and several settings or readings of the condensers are noted and a curve can then be plotted through them in the usual way. For instance, the standard wave meter is set at 10 degrees along the scale of same, and if this corresponds to, say,

200 meters wave length then when the loudest signals are heard in the telephones connected to the second wave meter under calibration (which tuning is done by moving the condenser handle over the scale of same) then the point of loudest signals as indicated on the condenser scale corresponds to 200 meters wave length, and this point should be noted.

This process is repeated about every ten degrees around the scale successively, and then all of the points and wave length equivalents are plotted on some square



Calibrating a Wavemeter.

ruled cross section paper and a smooth, symmetrical curve may be drawn through the points.

Relative to construction data for undamped wave receiving tikkers would say that a very good idea on same was published in the April, 1915, issue of this journal on page 228, and copy of same can be procured at 5c.

You will find a number of tables given showing increase in wave lengths when one or more wires are added on parallel to an aerial in any of the standard radio handbooks, such as those by Dr. J. A. Fleming.

LIGHTNING SWITCHES.

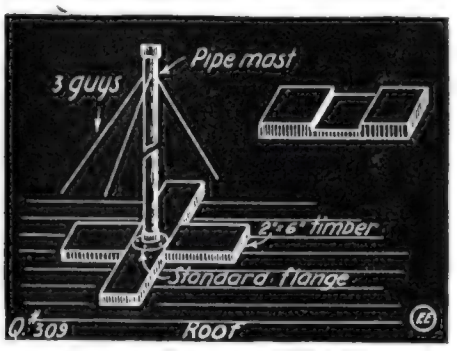
(308.) D. W. Vallow, Sebring, O., asks for data on lightning switch construction.

A. 1. The copper bar you mention will be all right for lightning switch construction and the moving blade should be 1 inch in width if it is ⅛ inch thick. The blade may be about 5 to 6 inches long and the whole may be mounted on a slate base or preferably on a marble base.

IRON PIPE MAST BASES.

(309.) Patrick J. L———, Boston, Mass., wants an idea on mounting the base of an iron pipe mast on gravel coated roof so as not to damage it.

A. 1. We suggest in the sketch a way in which to mount your small iron pipe mast on top of a roof, as you mention, so



Mounting Iron Pipe Aerial Mast on Roof.

as not to damage it. A common way to do this is as indicated in drawing, and the mast here has a substantial foot or base arranged under same, made of some fairly heavy timber, say 2 by 6-inch yellow pine.

If such a mast is properly guyed with about three guy wires, such as stranded galvanized guy cables, it will retain its posi-

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This instrument increases the audibility
ONE THOUSAND FIVE HUNDRED TIMES

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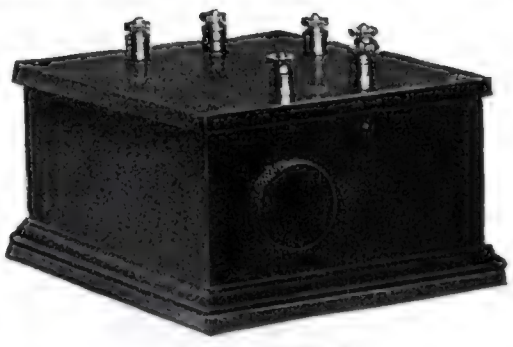
Price, $30.00

SIGNALS CLEARLY HEARD AND ACCURATELY READ WITHOUT HEAD-SETS

The amplification is so great that when two Multi-Audi-Fones are used in tandem and a horn is attached to the receiver, the signals can be heard all over the five story building from our laboratories which are located on the third floor. If the windows are opened, the signals can be heard across the street, even when the trolley is passing.



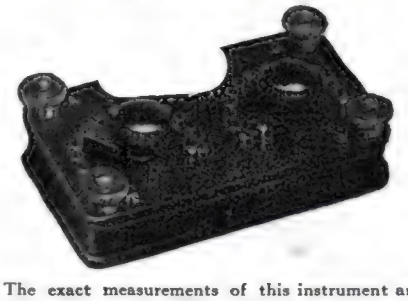
MULTI-AUDI-FONE

The exact measurements of this instrument are 4¼x3x2½ inches. Weight, 12 ounces

It increases the audibility one thousand five hundred times

MULTUM IN PARVO

(Much in Little)



The exact measurements of this instrument are 3¼x2x⅞ inches.

This instrument is indeed "much in little." It is a marvel of efficiency and campactness, for it combines the CRYSTALOI DETECTOR, which is superior to any other, with a COMPLETE AND PERFECT RECEIVER.

The Crystaloi Detector especially designed for us becomes far more sensitive when used in combination with our Multum in Parvo. This compact little instrument has a wave length ranging from 50 to 3,600 meters, and will go into your vest pocket.

Price, $20.00

These instruments in combination have a receiving range of 3,000 miles. They are beautifully finished in triple nickel plate and made of hard rubber composition.

One Hundred of These Outfits Sent On Free Trial

Naturally we must follow the rule of first come, first served. Therefore, if you do not get your outfit at once you will understand that there are others ahead of you and that you will get yours when your turn comes.

Offer to Radio Clubs or Others

We will send, at our own expense, one of these complete outfits to any radio club or any two persons. If you want to try this newest and greatest wireless improvement, sign the following letter. Have it guaranteed by your father or some other responsible man, and we will send the outfit to you on trial.

MULTI-AUDI-FONE: 273 Morris Ave., Elizabeth, N. J., 1915.

Gentlemen:—Please send us, at your expense, one of your complete outfits upon these conditions: First—We agree in no way to mar or injure any of the instruments by taking them apart. Second—We agree to repack carefully any of the instruments we do not buy in the same box in which we received them. The prices of these instruments are understood to be: Multi-Audi-Fone, $30; Multum in Parvo, $20. Head-Set, $5; the outfit, $55. Third—We agree to remit within ten days of receipt of the instruments for such of them as we decide to purchase and to repack the rest as above agreed, and return the same at your expense within ten days after they are received by us.

Very truly yours,

Two Signatures are required

No apparatus will be sent unless responsible person signs this Guarantee

(Name)..... Address.....

(Name)..... Address.....

I hereby guarantee that the above agreement will be faithfully kept and performed.

(Name)..... Address.....

SIGN—TEAR OFF—MAIL TO-DAY

Send For Our Circular. Correspondence Solicited.

MULTI-AUDI-FONE—273 Morris Avenue, Elizabeth, N. J.

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HAND LANTERN

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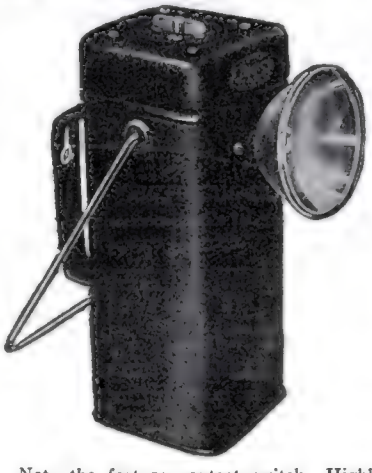

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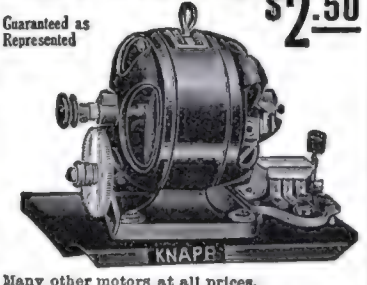

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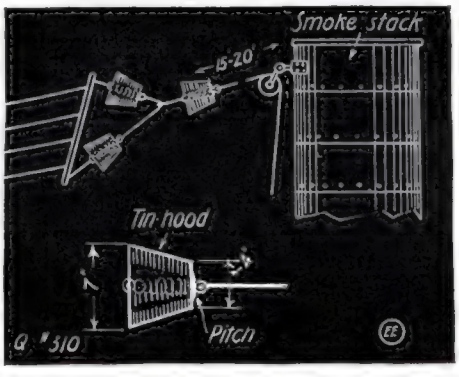
tion all right even in a high wind. Of course, the larger the base timbers are made the more stable the mast will be, and it should in no case be less than 4 to 5 feet in spread.

AERIALS ON SMOKE STACKS.

(310.) Ralph Liddle, Lake Benton, Minn., says he has facilities for erecting a good sized aerial on a steel smoke stack and wants our opinion on it.

A. 1. We might say that there are many wireless plants erected or installed under the conditions you mention, and iron smoke stacks are often used to support aerials very successfully.

It is well in such cases to leave quite a space between the stack and the spreader, say 15 to 20 feet or more, so that smoke or soot from the stack will not coat the spreader and its insulators, thereby providing a bad leak to the ground. It would be very advisable in such cases also to place a metal hood on one end of the insulator, as the sketch herewith shows, to keep the soot



Aerial Fastened to Steel Smokestack.

from the stack from falling on the insulator and destroying its high dielectric value.

A DEMAGNETIZING COIL.

(311) James McIntyre, Bridgeport, Conn., inquires for data on making a demagnetizing coil for machine tool work.

A. 1. Unless you have alternating current available you cannot arrange to use a demagnetizing coil in the way you suggest.

It is not practical to make any form of current reverser or commutator for use on 110 volts direct current, which we presume you use on magnetic chuck, of course, and hence you would probably have to use batteries with a small reverser or commutator, rotated by hand, etc., in series with the demagnetizing coil.

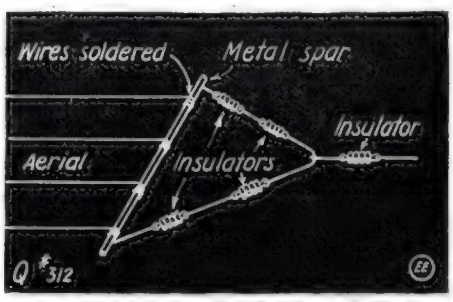
If you use 10 or 12 dry cells in series with a commutator or reverser, arranged for hand or motor drive, you could then use a demagnetizing coil consisting of about one pound of No. 18 insulated magnet wire wound into whatever shape you desire the coil to conform for your special requirements.

AERIAL INSULATOR ARRANGEMENT.

(312) Bertram E. Smith, Spring Valley, N. Y., shows two methods in his sketch of placing insulators in aerial spreader ropes, and wishes to know the best of the two schemes,

A. 1. The first method you show in diagram (here reproduced) of arranging four antenna insulators in series in the spreader supporting ropes is practically as good as any, and of course the more insulators you place in series the better the insulation in every way, as the resistance of such an arrangement is naturally higher.

It is quite common to use a metal pipe spreader in such a case, joining the aerial strands to the metal spreader and making sure that a good circuit is produced between it and the strands, etc., by soldering or other means.



Arrangement of Aerial Insulators.

IRON WIRE CIRCUITS.

(313) J. H. Emrick, Neopolis, O., inquires about iron wire resistance, etc.

A. 1. The 75-ohm Gernsback type relay will operate through circuits having 30 to 40 ohms resistance, and should operate in your case very nicely indeed.

The No. 12 iron wire of common E. B. B. grade has a resistance of 28.46 ohms per mile and "steel" grade wire has a resistance of 30.36 ohms per mile. This data is taken from the wire tables corresponding to the stock carried by the John A. Roebling's Sons' Co.

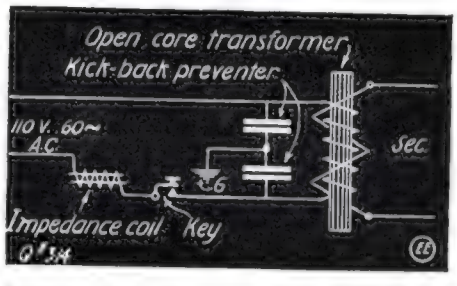
IMPEDANCE OR REACTANCE COILS.

(314) Thomas Robinson, Chicago, Ill., asks the meaning of "impedance" and "reactance" coils; also their connection in radio transformer circuits.

A. 1. The term "impedance" or "reactance" coil is used indiscriminately, generally speaking, and refers to a coil of wire usually provided with an iron core of laminated form and the coil to be used for controlling the amount of current passed through a circuit or for other purposes, such as choking back the high-frequency oscillations produced by radiophone arc generators, etc.

Diagram, as you request, is given herewith for the connection of open core transformer of wireless type, together with impedance coil in the primary circuit, for controlling the amount of current used.

It also has been found in practical radio



Kick-back Preventer and Open Core Transformer.

installations that such adjustable impedance coils in the primary transformer circuits can be used very efficiently to help tune the radio transmitting set, as regards the total resonance characteristics of the primary and secondary circuits of the transformer.

CONCERNING FILINGS COHERERS.

(315) George L. H—— wishes information on adjusting coherers for wireless sets, as he is having considerable trouble with such a set.

A. 1. Of course, coherer outfits have to be very finely adjusted in any case, and the Marconi coherer sets which were used

some years back were indeed very complicated and fitted with a great number of condensers, choke coils, shunt coils, resistances, etc., in order to make them work as nearly perfect as possible.

However, the Editor of this column has had a great deal of experience with coherer outfits, and can truthfully say that the *Electro* coherer which you have can do very good work indeed, considering its simple make-up. The coarseness and quality of the filings used in the coherer are of great importance, and you can experiment a little along this line to your own advantage, undoubtedly. A good mixture for these filings, and which, by the way, should be quite coarse, is that consisting of 85 per cent. steel grains and 15 per cent. silver. This mixture may be varied until best results are obtained.

The filings should never be touched by the fingers, as the oil of the skin will spoil the sensitivity of the grains. They should always be handled by a small piece of paper bent into a funnel shape or by means of a clean pair of tweezers.

The E. I. Co. 2-inch spark coil has about 50,000 turns of wire in the secondary and 150 turns in the primary. The No. 7,000 *Electro* Tesla transformer has about 30 turns in the primary and 1,000 turns in the secondary.

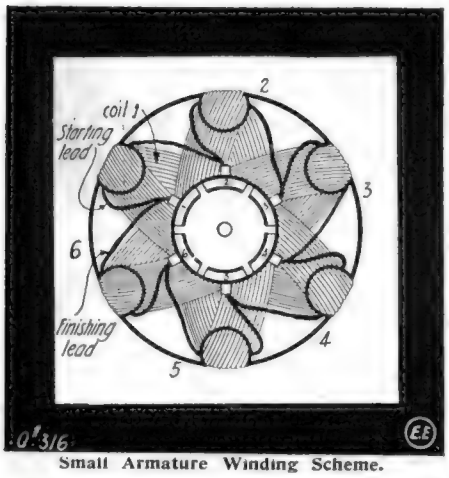
---

(316) Ervin R. Musgrave, French N. M., asks several questions regarding armature winding, storage battery plate design, etc.

A. 1. Diagram is given showing how the winding on the type SS dynamo armature is carried out. Six coils are wound on same, overlapping each other, while the leads from the coils are consecutively joined to the commutator segments as indicated.

In rewinding the armature on your telephone generator about No. 22 insulated magnet wire should be wound on same until it is solid and also quite full. A two-segment commutator must be used if the machine is to give direct current, so as to operate small battery motors, etc.

In regard to the design of the storage batteries and the allowance made in the size of the plates with respect to the ampere-hour capacity, the standard American rule is to allow 50 ampere-hours capacity for every square foot of positive plate surface. It should be borne in mind that invariably the positive plate surface is figured as the length times the height of the plate multiplied by 2, as this plate in most cases is placed between two negative plates, and hence both sides are active in the action of the battery.



Small Armature Winding Scheme.

The standard design of such lead batteries covers the use of practically in all cases one more negative plate than there

OWN YOUR OWN WIRELESS

A Complete Wireless Station

Our Universal Cabinet Type B has for its three cardinal features Compactness, Neatness and Efficiency.

COMPACTNESS: All the instruments required for sending and receiving are mounted on a handsome cabinet. There is no necessity for any accessories: the cabinet is a complete wireless station. A drawer is provided in the bottom of the cabinet for spare crystals, pencils and paper and other odds and ends which are used by the operator.

NEATNESS: The Type B set is most handsome in appearance. The cabinet is furnished in solid oak or mahogany, finished with the greatest care. All the brass parts are highly nickel plated and polished. The various parts have been made and finished by skilled labor—there is a commercial touch to the entire set that is lacking in most amateur apparatus.

EFFICIENCY: The various component parts of the receiving and sending apparatus have been selected and designed with a view to making an efficient unit. The tuner is supplied with a winding of either cotton or silk covered wire or bare wire, according to the purchaser's wishes. The potentiometer is absolutely unbreakable and regulates battery current to a fine degree. A potentiometer switch is provided to disconnect the battery when it is not in use, thus saving the battery. Fixed condensers are provided in the receiving set. For sending a ½-inch coil and high capacity helix, as well as a solid brass wireless key of commercial design, are the main features. **The set will receive from stations 1,200 miles away when using 1,000 ohm receivers.**

Price of the Universal Cabinet Type B: With two 80-ohm double pole receivers with 6½ feet of silk covered cord and nickel plated head band . . . $11.95

Price of the Universal Cabinet Type B: With two 1000-ohm double pole receivers with 6½ feet of silk covered cord and nickel plated head band . . . $13.70

Send a two-cent stamp for our interesting catalogue and a special code chart printed on unbreakable fibre. Remember our guarantee: If on receiving our apparatus you find that full value has not been given you, your money will be refunded immediately.

Universal Wireless Co.
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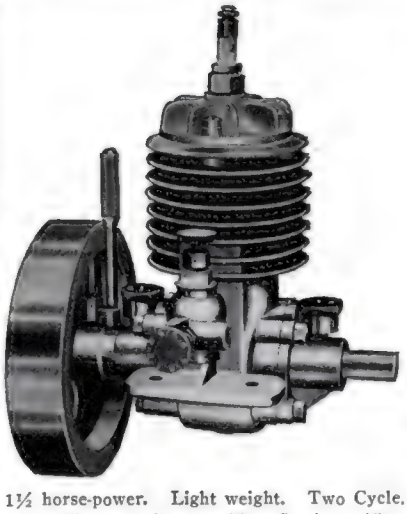

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These are all smooth clean castings and with each set are included full size blue print working drawings, all screws, nuts, springs, fiber, brass and steel stock, packing and finished bronze bushings, spark plug and compression grease cups.

Price, per set.....$10.00
7-inch 2 blade aluminum propeller casting.. 1.00
2¼x1¼-inch face pulley casting..... .50
Extra for machining and assembling carburetor 1.25
Extra for boring and facing cylinder and crank case 3.50
Blue Prints, only..... .50

1½ horse-power. Light weight. Two Cycle. Air Cooled. Bore 2½". Stroke, 2¼".

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Until you know them you don't know what tool satisfaction and tool economy is. No. 1124 plier with screw driver and prest-o-lite opener mailed for 50c. Helpful tool booklet free. Write today.

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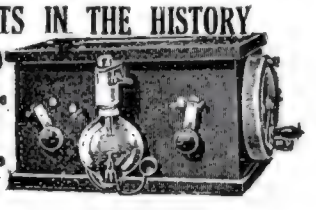

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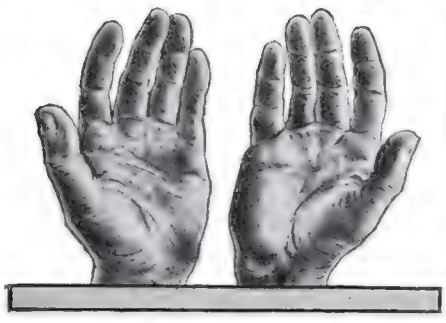

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Present Occupation _____

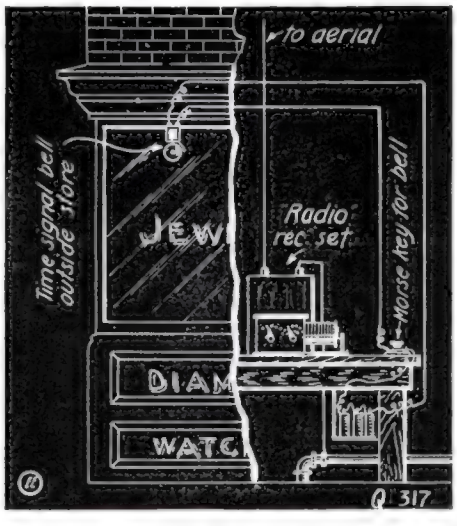
are positive plates in the cell to help as much as possible an equal electro-chemical action in the positive plate to prevent its "buckling," which tends to be the case when a negative plate faces but one side of the positive plate, instead of both sides. Also the positive plates are considerably more active electro-chemically than the negative plates, but they do not last as long, generally speaking, tending to disintegrate more quickly than the negatives.

For further data in this direction we refer you to either the Standard Hand-book for Electrical Engineers, price $5, or Storage Battery Engineering, by Mr. Lamar Lyndon, worth $3. These books are procurable from our book department.

RADIO TIME SIGNALS FOR THE PUBLIC.

(317) O. A. Duppstadt, Vadergrift, Pa., wants to make the wireless time signals audible to the public outside his store.

A. 1. Some jewelers arrange this matter by having a duplicate set of head 'phones available, which those interested may try on and so listen to the "time signals" coming in, and also some utilize a "bell" outside the store, connected with a Morse tele-



Electric Bell Signal for Radio Time Signals.

graph key at the radio operating table. As the time signal dots come in on the head 'phones the key is pressed each time, thereby giving bell signals outside of the store for the guidance of the public.

Needless to say, the bell must be arranged with respect to the wireless receiving instruments so that it does not interfere acoustically. This can be accomplished by placing the wireless set in a small booth, such as a telephone booth, if necessary.

STATIC MACHINES IN PARALLEL.

(318) A. J. Boldizer, Gallitzin, Pa., is interested in the parallel operation of static machines.

A. 1. We have never tried running static machines in parallel or in series, but but owing to the practical impossibility of synchronizing the discharges of these machines of the ordinary type, it does not seem practical to attempt such work. With special machines it may be possible.

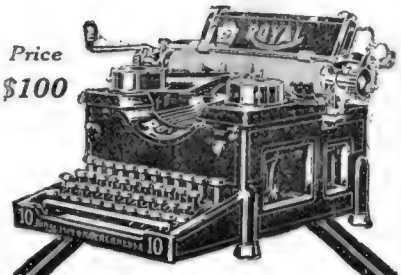
You will find data given in Nikola Tesla's book, at $1 prepaid, entitled "Experiments with Currents of High Potential and Frequency," on an arrangement whereby static machine discharges can be faithfully duplicated by means of high-frequency transformers and condensers, etc.

Briefly stated, the apparatus is arranged as follows:

G is an ordinarily constructed alternator,

(*Continue on page* 233.)

Price **$100**



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PATENT ADVICE

Edited by H. GERNSBACK

In this Department we will publish such matter as is of interest to inventors and particularly to those who are in doubt as to certain Patent Phases. Questions addressed to "Patent Advice" cannot be answered by mail. Sketches and descriptions must be clear and explicit. Only one side of sheet should be written on.

CAN A. C. TO D. C. MECHANICAL CONVERTER BE PATENTED?

(10) Phil D. Strong, Linwood Farm, Ia., sends in a description of a mechanical device to change alternating current to direct current.

His invention is accomplished by rotating shaft and a commutator, and the correspondent desires to know if it is an original invention and of any practical use.

(A.) Schemes of this sort have been used for quite a while back, and we remember a stage act where the performer converted alternating current to direct current by very similar means, but he used some very large specially arranged commutators for the purpose. The trouble with commutator devices of this kind is that there is too much sparking, and as a rule a much simpler means is provided to-day in chemical or vibrating rectifiers, neither of which spark as much as a commutator device.

While the rotary converters are based on a similar plan to that outlined by our correspondent, there are several phases that enter into their manufacture that make it quite a little different.

We do not think that a patent could be obtained on the device of our correspondent.

ROYALTY ON IMPROVED PATENTS.

(11) James J. Connolly, of New York, writes as follows: "If A invents an article and has it patented, B buys one of these articles and improves on it and has his improvement patented, must B pay A a royalty to manufacture A's article with B's improvement?"

(A.) In regard to the above we offer the following explanation:

It all depends what the invention is. If the improvement of B so changes the article invented by A that he makes a new article of it, then B does not have to pay a royalty to A.

If, on the other hand, the improvement of B is only an addition to the basic invention of A, then in that case B certainly must pay a royalty.

Cases of this kind are usually handled in this manner:

If A has an article on the market and B improves upon it in such a manner that it will make the article more valuable than the original one manufactured by A, it will usually be found that B sells his invention to A; and in an extreme case A allows B to manufacture it, having B pay a royalty on the article.

From the above it will be seen that it all depends on the nature of the invention or improvement, and it is impossible to give further advice without knowing the details.

MORE DETECTOR PATENTS.

(12) W. B., of Uniontown, Conn., wants to know if he could patent a galena detector stand, using two phosphor-bronze wire contacts instead of one.

(A.) We have repeatedly stated that small constructional details in any apparatus do not afford the inventor, even if he could obtain a patent (which is doubtful) any protection. We would discourage all inventors from trying to patent articles which only show small improvements on the article and which do not show distinct material changes. Patents of this class are termed "improvement patents" and as a rule are not worth much, as anyone can easily go around the few claims and substitute another device, which usually works just as well or better.

Even very strong patents which have a great many claims and are quite original are often improved upon or their claims are simply evaded, and it is almost hopeless to patent anything that is not quite original.

We desire to cite a point in case.

About a year ago there was invented by a New York inventor a flashlight in the form of a fountain pen. The patent in this case was the "clip contact" of the flashlight, which "clip" made contact to light the flashlight and at the same time was used to hold the flashlight in one's pocket similar to an ordinary fountain pen. Up to this time of writing some six flashlights are in the market, all having the same feature as stated above, and not one of them really infringing on the original patent. The newer construction simply evaded the original patent by changing the construction slightly, and the original owners are powerless to prosecute, for their original patent does not cover the later designs.

From the above it will be seen that if an inventor has an article which he thinks a really good one, he should try and *cover himself* as thoroughly as possible by submitting to his patent attorney as many variations as are anywhere practical, in order to afford full protection.

REGARDING FOREIGN PATENTS.

(13) Elmer B. Garey, Pittsburgh, Pa., wants to know in what other countries besides the United States a patent should be applied for on an important invention.

(A.) This is really a case for a patent attorney, and without knowing what the invention is it is almost hopeless to give any information. It depends entirely what the article is to be used for and which country it would interest most.

Offhand, we would say that if the patent is important patents should by all means be obtained in the following countries. We also append the cost of patents in the various countries:

Australia	$120.00
Canada	87.50
France	96.00
Germany	113.50
Great Britain	82.00
Japan	120.00
Russia	142.50

Of course there are a great many other countries in which patent protection would quite possibly benefit you, and we advise that you should take up this matter with a competent patent attorney for your own protection.

PATENTING LOUD TALKING TELEPHONES.

(14) Alfred B. Lewis, Chicago, Ill., has invented a loud-talking attachment for the ordinary Bell telephone, the idea being that the ordinary receiver will talk loud enough to be heard in the room. He wants to

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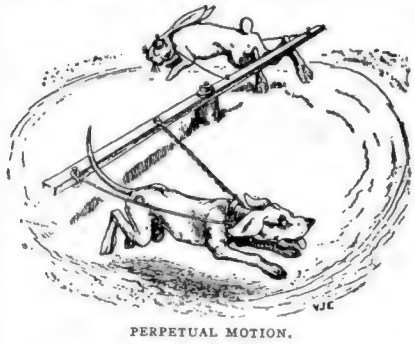

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know if such an invention is practical and whether a patent should be obtained.

(A.) There have been invented quite a few of these devices which usually are merely "acoustic" attachments to the receiver. While in some cases such an attachment may be used, there is really not much practical use for same in the average business office. Most people would certainly not have any use for such a device, as the receiver in its present state of development talks loud enough. Again, most business men would strenuously object to such a device, as they do not wish others to know what is going on over the wire.

While there are of course uses for loud talkers, we would discourage inventions in this line, as they are not of a widely useful nature.

One-Magnet Bells.

(15) E. B. Miller, Newark, N. J., has sent us a model of an electric bell, which, instead of two electro magnets, has only one, but an iron return circuit is provided to obtain a good magnetic efficiency. He wishes to know if a device of this kind is patentable.

A. There have been quite a few of these bells on the market in the past, and while to the best of our knowledge none are manufactured in this country now, there are several German firms who make a very cheap bell and in order to save manufacturing cost provide only one magnet. These bells, however, are not looked upon favorably by the trade, although they are quite cheap. Inasmuch as bells of this kind have been on the market quite a while back, we are quite sure that no patent can be obtained on such a device.

Collapsible Aerial Mast.

(16) H. Forsythe, Elizabeth, N. J., has submitted a drawing of a portable collapsible wireless mast, and wishes to know if the design is practical and whether a patent can be obtained upon it.

A. We have come to the conclusion that the idea is a very good one; we have never to our mind seen anything like it, and from the records obtained in our office, we have concluded that a mast of this kind can be patented. There should be quite a demand for such an article as there is none on the market now, and we would advise you to get in touch with a patent attorney to prosecute your invention. We think it is worth patenting.

What to Invent?

(17) Sylvian McNast, San Diego, Cal., writes us as follows: I have a lot of time on my hands and am very handy with tools, also know a good deal about electricity. I am of an inventive turn of mind and think that if I had a list of articles that are worth while inventing I could perhaps make a success with one of them. Will you be kind enough to publish a list of inventions that are necessary and wanted just now?

A. We have not the space at our disposal to publish a list showing what things to invent as such a list is necessarily very large and at best is incomplete. However, we understand that several of the patent attorneys are printing comprehensive booklets giving lists of articles and objects which await patenting and should net their inventors considerable sums.

We advise you to write to the patent attorneys whom you will find in our advertising columns and we are sure that you will find a lot of food for thought in their literature.

"Financial" Advice.

(18) A. M. S., Peoria, Ill., says he has made an invention which his attorney advises him to patent, but he lacks the funds to obtain a patent and asks our advice what to do in a case of this kind.

A. Cases of this kind are very common indeed, and the only thing to do is to show the invention to some friend or friends in whom you have sufficient confidence and induce them to either loan you the money, or, if this cannot be effected, induce them to share the profits of the invention by selling them an interest in the patent when same is issued by the Patent Office. The latter is, perhaps, the better advice, particularly if you can find someone who thinks well of the invention.

RADIO-AMATEURS JOIN IN RELAY LEAGUE FOR WAR WORK.

Should Uncle Sam ever go to war, he will have to thank a group of young New England amateur radio-experts not only for helping establish the most comprehensive auxiliary wireless system of any country in the world, but also for a rivalry among the thousands of United States amateur workers that could be used to reinforce many times the present wireless network of the country at a minute's notice.

In connection with the formation of the American Radio Relay League by Hiram Percy Maxim of Hartford, ten special amateur licenses have been granted in the New England district, upon recommendation of Henry C. Gawley, the government radio inspector here. Without exception every one of the remaining 700 active amateurs in the district are now seeking to secure the coveted privilege of heading a special relay station such as the special amateur license permits. Thousands of young amateurs in districts all over the United States are seeking the same coveted honor.

Wireless messages under the special permit can be relayed as far as Chicago and even farther West.

The ten lucky New England men are permitted for relay purposes to use a 425 metre wave length, while the general amateur is restricted to a 200 wave length.

Each special license amateur is closely investigated by Inspector Gawley, reported as possessing an A1 equipment and receives his permit direct from Secretary Redfield of the United States Bureau of Commerce at Washington. He is also designated with a special call letter.

His appointment is specially significant since Uncle Sam grants a special license only after having made sure that the recipient will materially benefit his wireless service.

Mr. Gawley, in discussing the new relay chain, said:

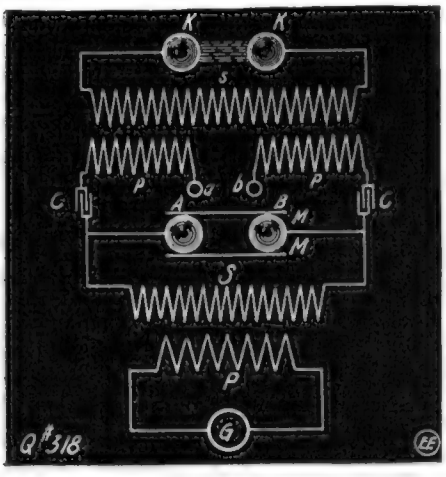
"The League will be of immense help in case of war. It adds to my duties, but on the other hand it brings me into much closer touch with the special amateurs and helps to perfect the government's control over all the wireless amateurs in the league.

"The permits are granted only from year to year. The special license assures us of an active station. If it is not active a license renewal will not be granted. In this way the entire wireless field is carefully guarded. The league members can relay messages from Coast to Coast, and, in fact, to all parts of the country, the maximum distance being about 400 miles.

QUESTION DEPARTMENT.

(*Continued from page 230.*)

supplying the primary P of an induction coil, the secondary S of which charges the condensers or jars C C. The terminals of the secondary are connected to the inside coatings of the jars, the outer coatings being connected to the ends of the primary



Imitating a Static Machine Spark with High Frequency Coils.

p p of a second induction coil. This primary p p has a small air gap a b.

The secondary s of this coil is provided with knobs or spheres K K of the proper size and set at a distance suitable for the experiment.

A long arc is established between the terminals A B of the first induction coil. M M are the mica plates.

Each time the arc is broken between A and B the jars are quickly charged and discharged through the primary p p, producing a snapping spark between the knobs K K. Upon the arc forming between A and B the potentials fall, and the jars cannot be charged to such high potential as to break through the air gap a b until the arc is again broken by the draught.

In this manner sudden impulses, at long intervals, are produced in the primary p p, which in the secondary s give a corresponding number of impulses of great intensity. If the secondary knobs or spheres K K are of the proper size the sparks show much resemblance to those of a Holtz static machine.

A. 2. A sinusoidal current is merely an alternating current which changes from positive to negative many times a second, and having a symmetrical wave form.

TELEGRAPHONE QUERY.

(319) J. W. Arnold, Little Rock, Ark., asks how many times the steel wire in the telegraphone may be used to record messages on, or if it can only be used once.

A. 1. The arrangement you speak of will probably work out very well for use in conjunction with the telegraphone. The steel wire used in the telegraphone is, of course, used over and over again, and the "talk" registered on same magnetically is obliterated or removed by simply reversing the wire through the machine and bringing in close proximity to the moving wire a steel horseshoe magnet, which demagnetizes the wire so far as the message on it is concerned. In the commercial machines an electro-magnet is generally used for the purpose.

HIGH VOLTAGE RECTIFIERS.

(320) W. C. Ewing, Fayetteville, N. C., wants to know if an electrolytic rectifier such as the E. I. Co. build, can be used

(*Continued on page 234.*)

DOCTOR GIVES AID VIA WIRELESS.

The wireless invention has again proven its value. Capt. Lane, of the steamship "Bradford," arrived at Philadelphia from Tuxpan, Mexico, and tells a story that on the second day out a sailor was taken ill. No physician being on board the wireless operator swept the sea with his wireless in search of one. A British warship answered, but refused to give her location, and said she could not leave her post. The man's symptoms were wirelessed to the ship's doctor, who diagnosed the case as pneumonia. The physician then wirelessed a prescription to Capt. Lane.

AIRMEN ADD TWO TO NAVY BOARD OF INVENTORS.

The nomination by the Aeronautical Society, at the request of Secretary Daniels, of Hudson Maxim and Matthew B. Sellars for members of the Naval Advisory Board on Invention brings the membership of the board up to seven, the other members being Thomas A. Edison, Alexander Graham Bell, Orville Wright, Henry Ford and Charles P. Steinmetz.

The Aeronautical Society is the first of the various engineering and scientific societies to respond to Secretary Daniels's request that they nominate from their membership for places on the board.

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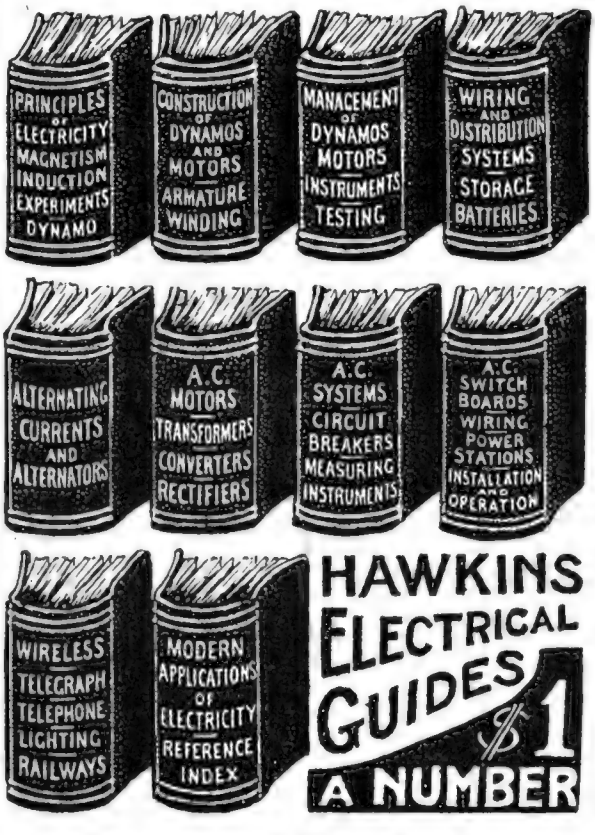
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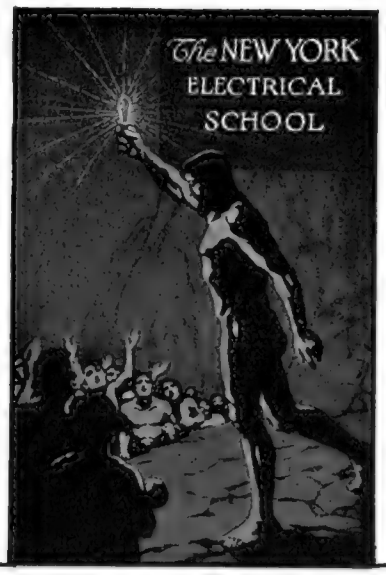

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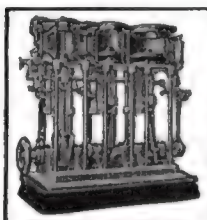

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for rectifying high-voltage alternating current, such as 90,000 volts.

A. 1. We believe that special apparatus working on the vacuum tube principle probably can be furnished by the General Electric Co., Schenectady, N. Y., to produce high-voltage direct current in the form of a static charge for the purpose you have in mind. Its Kenotron rectifier tubes, for high alternating-current voltages, should be all right for your work.

WILL INDUCTION COILS OPERATE ARC LAMPS?

(321) A. L. W——, Isle of Pines, W. I., speaks of using an induction coil for operating arc lamps.

A. 1. Induction coils cannot be used to operate arc lamps or other such apparatus, owing to the high voltage of the current and to the low amperage of same, and to the fact that this secondary current is an unsymmetrical one of irregular frequency with many long "dead" time periods. Induction coils may be made with any voltage ratio existing between primary and secondary windings desired.

The voltage ratio is primarily dependent upon the number of turns in the secondary coil compared to those in the primary coil. For instance, a secondary coil composed of 500 turns would give an increase of twice the primary voltage if the primary winding comprised 250 turns of wire, and vice versa.

UNBALANCED 3-PHASE A. C. SYSTEM AND WIRELESS RECEIVING.

(322) Barney Lawson, Houston, Tex., inquires about an "attic" indoor type aerial he has erected, and wonders if it would pass the Fire Underwriters' inspection.

A. 1. The aerial you mention would most probably be all right from the electrical and Fire Underwriters' point. We would strongly suggest, though, that with such indoor aerials lightning rods be placed on the exterior of the roof of the house.

If you employ an "L" shaped aerial it is best to connect the lead-in to one end of same.

We do not believe that any unbalancing of the three-phase system you speak of would materially affect the wireless receiving apparatus, so far as can be judged without knowing exact details as to the relative position and location of all of the apparatus, its wiring and nearby alternating-current circuits, etc.

TRANSFORMER DATA BOOKS.

(323) Dr. C. C. W——, Buffalo, N. Y., desires transformer construction data and books bearing on the subject.

A. 1. The data you desire, generally speaking, is given in Mr. Curtis' excellent 25-cent book entitled "Construction of Induction Coils and Transformers."

Another excellent work which will be of great service to you in this direction and containing data for all sizes of wireless transformers up to 5 kw., given in considerable detail with tables, etc., is the work known as "Wireless Telegraphy and High Frequency Currents," by Prof. La V. Twining. Our book department can furnish this book at $1.50 prepaid; also the book by Mr. Curtis.

The method of calculating the secondary and primary windings is thoroughly explained in this book by Professor Twining, as well as a host of other problems in this direction.

RADIO SIGNALS NOT CONSTANT.

(324) A. B. Rowland, Stuttgart, Ark., complains that incoming wireless signals at his station have for a year or more tended to start off strong and then faded away. He has been unable to locate any faulty circuits.

A. 1. The conditions you mention in your wireless station are common, and in most cases that we have investigated of this nature it has usually been found that the trouble is due to a loose or faulty connection at some point.

In one case it was found to be due to a swinging loose joint in an aerial lead-in wire. Sometimes this swinging joint, which was not a perfect one, would open the circuit, so far as the reception of wireless signals was concerned.

We have looked over your query carefully and would suggest in closing that you very carefully examine every piece of apparatus in your set, and especially the binding posts, etc., to see that they are firmly tightened up. Changing sensitivity in the detector is sometimes the cause of this trouble (check this by throw-over switch and two detectors), and a swinging aerial can cause this phenomenon. Atmospheric electric charge variations possibly have some effect.

REGARDING DR. COHEN'S NEW NAVY RECEIVING SET.

(325) Spencer Hass, Kankakee, Ill., asks several questions about Dr. Cohen's new navy type radio receiving set.

A. 1. Relative to the article published in *The Electrical Experimenter* for July,

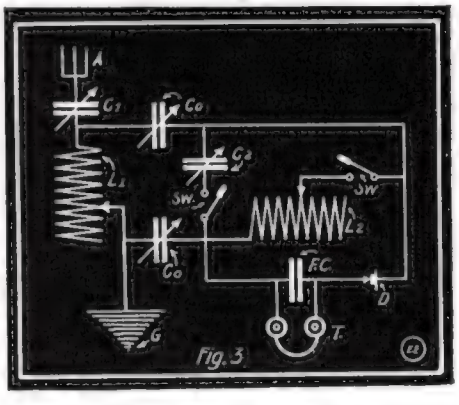

Diagram of Dr. Cohen's Improved Navy Type Receiving Set.

1915, on "Dr. Cohen's New Navy Type Wireless Receiving Set": The inductances L^1 and L^2 are in the form of tuning coils, as you suggest. These may be of different sizes, depending upon the wave length values required for the circuits. Several of our readers have communicated with us, stating that they have found this system very fine indeed, and much superior to anything they had ever tried heretofore.

The purpose of the two switches in the tuning circuits is to enable the inductance L^2 or the variable condenser C^2 to be cut out when tuning this set to different wave lengths. When inductance L^2 is cut out of circuit the path of the oscillations is through inductance L^1, around the circuit through condenser, say C O, to the detector D, thence thru fixed condenser F C and on through the second variable condenser C O back to inductance L^1.

When inductance L^2 is in use in the circuit, then the oscillations are tuned through L^1, two variable condensers C O, and C O and inductance L^2.

The set works similar to an ordinary wave meter, and the detector and fixed condenser F C, with 'phones across it at T, simply act to detect when maximum resonance takes place in the closed oscillatory circuit just mentioned.

The vertical and horizontal wires just below the condenser C^2 are joined as you

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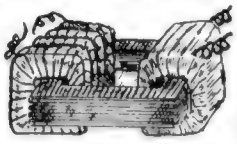

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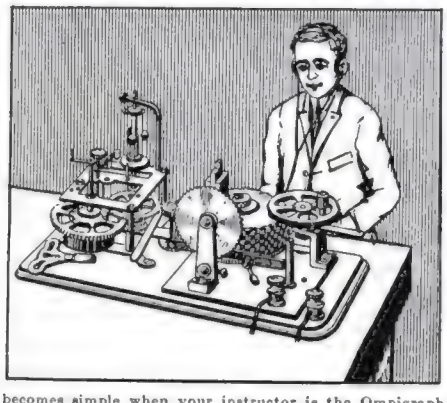

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mention. The variable condensers may have a capacity of any ordinary value, and of course this depends upon the wave length to which the set is tuned. An ordinary value for same would be .001 M. F., and larger condensers may be used, giving greater wave-length capacity.

CHANGING SERIES DYNAMO TO SHUNT.

(326) J. D. Dalney, Dallas, Tex., has a small dynamo which he wishes to convert from series to shunt-wound type, i. e., with the field winding hooked across the armature brushes.

A. 1. You will undoubtedly have to rewind the field of your machine of the series type if you desire to convert it into a shunt-wound machine.

Generally speaking, the field coils should be rewound with magnet wire about 4 to 5 sizes smaller in circular mils area than the wire at present in use for the series field. About the same amount of wire should be used as regards weight, or also a proportionately greater amount of turns should be placed in the coils.

ELECTROLYTE DENSITY FOR INTERRUPTERS.

(327) H. Bennett, Clarinda, Ia., wants to know the specific gravity of electrolytic interrupter solution.

A. 1. In regard to the solution used in the Gernsback electrolytic interrupter, would say that sulphuric acid only has to be added every couple of months or so.

The specific gravity, if measured by a hydrometer, should register about 1,210 degrees.

The solution in the interrupter is kept up to its proper level by the addition of pure water from time to time as necessitated by the evaporation of the water in the solution.

A NEW DRY CELL SEARCHLIGHT.

There are numerous uses for a vehicle searchlight that may be operated successfully from dry cell batteries. The new Pittsburgh searchlight, illustrated herewith, employs a powerful focusing lens in connection with an 8-inch parabolic reflector, which produces a beam of light with ample power for automobile and motor boat use. The current consumption is only one ampere (thus making the ordinary dry cell battery an economical source of current supply). The bulb is a 6-volt Mazda, and the lamp can therefore be used with any 6-volt lighting system, or with ordinary dry cells. For automobile use it may be mounted on the door or wind shield. It not only serves as a searchlight for reading signboards, turning and backing, but answers the purpose also of an auxiliary headlight for use in emergency cases. It gives the gas-lighted car the use of an electric light whenever needed.

New Auto Lamp — Works on Dry Cells.

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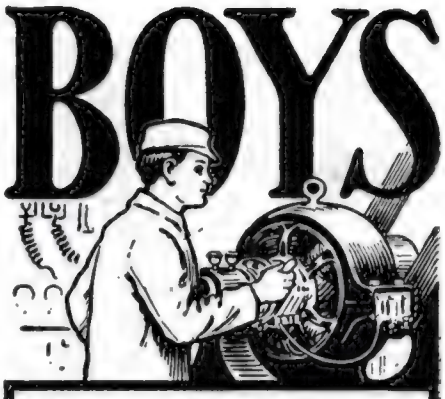

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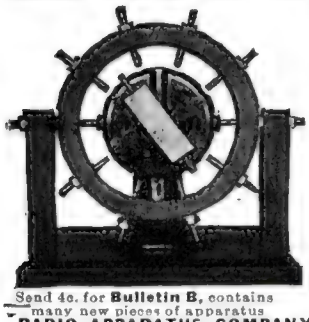

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THE WONDERS OF RADIUM.

(*Continued from page* 183.)

Upon focusing the lenses and upon looking through them, one will see that the screen is continually giving forth small sparks, which as the Radium salt is brought closer to the screen, increases the brilliancy and frequency. A beautiful scintillating effect is obtained, impossible to describe. In our Fig. 10 we see a magnified view of the lighting up of the screen on the inside of the Spinthariscope, one-half of the screen having been covered up.

Our Fig. 11 shows a very enlarged view of the inside of the Spinthariscope, but it does not adequately show the beautiful color effects obtained with this instrument. It goes, of course, without saying that there is nothing to wear out in this instrument and it will last as long as the speck of Radium will last, i. e., 2,500 years and longer. It was with this instrument that Crookes demonstrated that the emanation of Radium consisted of millions of positively charged atoms hurled off from the Radium salt with terrific velocity, and it is this which causes the particles of the zinc sulphide to sparkle and glow.

We have stated elsewhere that Radium is capable of giving off a tremendous amount of heat. Indeed, this shows us a way where future man will smile when he reflects how we used coal to-day, which gives but 5 per cent. of its actual energy when translated into steam, the rest being carried off as waste heat. The future man will, no doubt, laugh at the idea of how we had been using **6,000 tons of coal** for a single trip (costing some $12,000, valuing coal at $2 per ton, which is very cheap), to propel a modern steamship like the "Mauretania" across the ocean, with the accompanying vast amount of **space** required in which to store these 6,000 tons of coal. Not only this, but he also will undoubtedly smile when he contemplates the very cumbersome machinery necessary in order to transform the latent energy in the coal into steam, when his amazement will be even greater.

It has been found that when burning one gram of coal that only about 8,000 calories of heat are obtained. In this change, however, 2⅔ grams of oxygen are consumed, so that per gram of the two compound substances we only get 2,200 calories of actual heat. This combustion is instantaneous. It must be renewed all the time, as coal will, of course, burn up very fast. If we now substitute Radium for coal we find that one gram of Radium develops 133 calories of heat per hour. There are 8,760 hours in the year; therefore, figuring on this basis, a gram of Radium will net us about 1,160,000 calories during the course of the year. In one year 1/2500 part of the Radium changes. Thus, during the complete change of one gram of Radium no less than 2,900,000,000 calories would be evolved in 2,500 years.

Considering this basis of energy transformation, the power latent in Radium is well over a million times greater than that furnished by the combustion of coal. This gives us a good idea of the tremendous power of the mysterious element—Radium.

To continue, with regard to driving a modern ocean greyhound across the sea by means of Radium instead of coal, the illustration at Fig. 12 will be of interest. This shows fairly well the small amount of space consumed by the Radium boiler which would undoubtedly be used on board the steamship.

Getting down to actual figures, we have seen that 6,000 tons of coal used for such steamships as the "Mauretania" would cost, let us say, on the average $12,000. It has been calculated that to give forth the same equivalent of energy for one trip of the steamship would necessitate the employment of .15 (fifteen-hundredths) of a gram of this precious substance, which is worth $96,000 per gram, according to the market figures which have prevailed previously. Thus the .15 gram of Radium (and considering that all of the energy in this fraction of a gram of Radium could be liberated during the five days' run of the steamship) would cost .15 of $96,000, or $14,400 This is a little higher than the cost of the coal, but it should not be forgotten for one moment that this Radium here proposed for propelling the steamship would only weigh the fraction of a gram, and there being 28.35 grams to the ounce, avoirdupois. Also the 6,000 tons of coal here involved would weigh 5,448,000,000 grams; or in other words, the coal necessary to be carried on board the steamship for a single trip would weigh approximately 35 billion times more than the total weight of Radium necessary. Again, and considering the new Government rate* just made effective for the reduced cost of Radium, which is one-third the old market price, the actual cost of the .15 gram of Radium would be $4,800. This does not even begin to mention the valuable space taken up by the ponderous machinery, boilers, bunkers for the coal etc., which with the Radium would, of course, fall away entirely. The only machinery necessary would be a small boiler with water, a turbine engine an[illegible] the speck of Radium. Our arrangement as shown at Fig. 13 could, of course, be used with modifications.

It consists of a boiler of spherical form having a radius of several feet and a small shell of iron, with the Radium hung in the center of the boiler, as shown. Such a boiler would, of course, take up but a very small space, and is readily installed. The energy supplied by the Radium is distributed equally in all directions, and therefore the heating of the water in every part of the boiler is practically equal.

Submarines could be easily propelled with this wonderful substance, which naturally would replace cumbersome oil engines, thereby preventing accidents from explosions and also the danger from fumes given off by storage batteries during the period when the vessel is submerged.

An interesting illustration of the marvelous power or rather of the inherent energy in Radium is shown in our Fig. 14. It seems incredible that such a ponderous structure as *the Woolworth building, weighing* 103,000 *tons, could be lifted by means of the energy evolved from* 1/50 *gram of Radium.* Nevertheless this is a fact. It has been shown that .0225 gram of Radium, costing $2,160, if caused to act through its normal life of 2,500 years continuously on a powerful electro-magnet, would furnish enough energy to lift the Woolworth building one foot above the ground, as shown in our illustration. Of course the illustration which we offer is only made to convey the idea graphically and is not in reality complete, for it would be necessary to first transform and store the electrical energy of Radium into a charging plant, such as a monster storage battery, charging this storage battery for a period of 2,500 years without interruption. At the end of this period we would have (theoretically) accumulated enough energy to actuate the immense magnet and for a few moments there would be enough energy at hand in our storage battery to lift the Woolworth building clear. In other words, we would

*As we go to press the Government announces that it has succeeded in producing Radium at a cost of $36,050 a gram, which is exactly one-third of the cost it was heretofore. This Radium is now produced from our Cornotite mines in California and Colorado.

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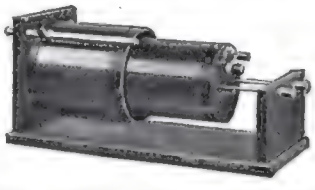

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have obtained enough power for a few moments to lift 103,000 tons one foot above the earth! And 1/50 gram of Radium accomplished it!

While the above example clearly demonstrates the tremendous inherent power that lies dormant in Radium, there are, of course, thousands of other applications which could be successfully worked for the benefit of man.

Verily, we have no conception of the marvels that lie buried in the future!

WIRELESS AND THE CLERGY.

A wireless dispatch of 80 words is being sent by the Canadian Government to the clergy on the Magdalen Islands in the Gulf of St. Lawrence, to be read from the pulpits each Sunday morning in order that the inhabitants, who are shut off from the outside world, may know of the progress of the war.

OMEGON.

(*Continued from page* 190.)

"It took two men to carry out wan of thim sleepin' kids, an' after a couple of trips they'd go to sleep thimselves. The ship's engines stopped an' th' second engineer—th' last man awake in th' engine room—a brown, wild-eyed little divil, crawled out an' hugged a stanchion close to me. Thin he slid down like a strip of liver an' closed his eyes.

"Thin th' Japs lowered their flag, an' soon after—hivin bless yez, Cawthorne,—th' flags of three other ships came down."

Ned stepped close, grasped the captain by both shoulders, and demanded: "The other boats, Mulray! Did you see anything of them?"

"Divil a——" But he was interrupted by the surgeon.

"A message has just come in from Gualala, Mr. Cawthorne. Your five submarines are there, and all well. They've put the enemy's flagship and four others out of commission and you haven't lost a man. I don't know what those boats cost you, but——"

Ned interrupted with a grin: "They cost, covering everything, less than three hundred thousand. That's outside of the *Sarah Q*. She's good value yet, and I've got some new work to put her at."

"Three hundred thousand!" gasped the surgeon. "And those five superdreadnaughts didn't cost less than fifty millions before they left the yards!"

That evening Cawthorne and the men who had operated the submarines with him supped together hilariously in the cabin of the *Sarah Q*. She was steaming back to San Francisco, the little boats in tow. As they lit cigars and pipes, Ned slipped a handful of checks into Kilroth's hand.

"Boys, I am sending round to you at once your checks for two thousand dollars, as I agreed. That's about a thousand an hour for this little adventure."

After the howl of delight subsided he went on:

"The Admiral has requested me to turn the submarines over to him to use against the southern squadron of the enemy, now making for San Francisco. I have agreed to do that; and he wants the crews also. That's up to you."

A roar of cheers greeted this statement. Captain Mulray sprang to his feet and shouted:

"We're yours, Cawthorne, hearts, souls an' bodies! Just you lead th' way, an' iv'ry damn Jap or Chinese dreadnaught on th' Pacific'll get th' Omegon paralysis!"

Cawthorne laughed and shook his head. "Can't do it, boys! You can handle the navy all right, but there's an army of the enemy getting ready to cross the Rio Grande. Submarines won't work there, so Kilroth and I are going to put a new round-up device in commission. We'll be ready for your help as soon as you're through with this other little Omegonizing job."

THE END.

ELECTRICAL SHIP PROPULSION.

If the electrical propulsion of a vessel of the United States navy seems a roundabout method of using the energy of steam, the results of a late Swedish experiment show that it should be far from wasteful. The "Mjolner" and the "Mimer" are sister steamers of 2,225 tons displacement each, the former being driven by electric motors fed by steam-turbine generators, while the second boat is fitted with ordinary triple-expansion engines. It was stipulated that, while each vessel should have a speed of 11 knots with engines developing 900

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We illustrate one hard shape we make. A pair of rolls 7½" long and 1¼" in diameter with 8 holes on ends and middle. They must be perfectly straight and we make them so. It's hard but not for us. We can make your difficult designs also. Send us blue print for quotations.

Union Electrical Porcelain Works

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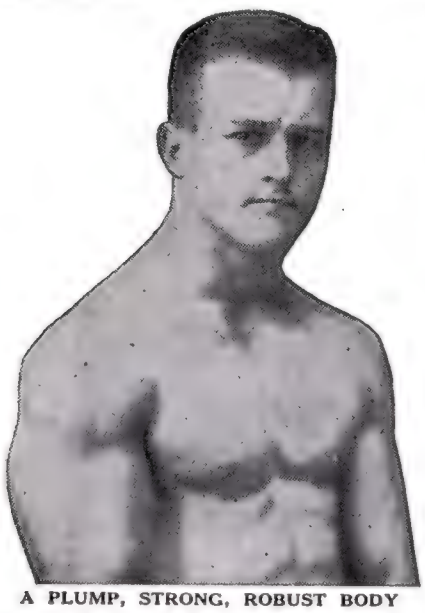
Remarkable Experience of F. Gagnon. Builds Up Weight Wonderfully

"I was all run down to the very bottom," writes F. Gagnon. "I had to quit work I was so weak. Now, thanks to Sargol, I look like a new man. I gained 22 pounds in 23 days."

"Sargol has put 10 pounds on me in 14 days," states W. O. Roberts. "It has made me sleep well, enjoy what I ate and enabled me to work with interest and pleasure."



A PLUMP, STRONG, ROBUST BODY

"Before I took Sargol people used to call me 'skinny,' but now my name is changed. My whole body is stout. Have gained 15 pounds and am gaining yet. I look like a new man," declared another man who had just finished the Sargol treatment.

Would you, too, like to quickly put from 10 to 30 lbs. of good, solid, "stay-there" flesh, fat and muscular tissue between your skin and bones?

Don't say it can't be done. Try it. Let us send you free a 50c. package of Sargol and prove what it can do for you.

More than half a million thin men and women have gladly made this test and that Sargol does succeed, does make thin folks fat even where all else has failed, is best proved by the tremendous business we have done. No drastic diet, flesh creams, massages, oils or emulsions, but a simple, harmless home treatment. Cut out the coupon and send for this Free package today, enclosing only 10 cents in silver to help pay postage, packing, etc.

Address The Sargol Co., 847-H Herald Bldg., Binghamton, N. Y. Take Sargol with your meals and watch it work. This will tell the story.

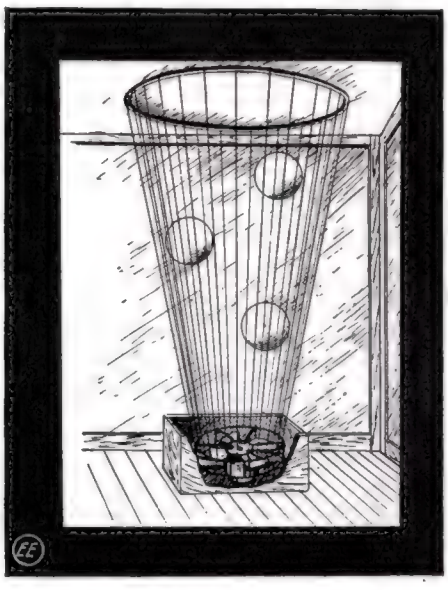
FREE SARGOL COUPON

This coupon, with 10c. in silver to help pay postage, packing, etc., and to show good faith, entitles holder to one 50c. package of Sargol Free. Address the Sargol Co., 847-H Herald Bldg., Binghamton, N. Y.

horse-power, the turbo-electrical vessel should use 30 per cent. less fuel than the other. In the trial trip of seven hours, the guaranty for the turbo-electrical vessel was much exceeded, for the engine developed 975 horse-power, the average speed was 11.8 knots, and the saving in coal consumption reached 35 per cent. The steamers are to be used in Swedish coast trade.

SHOW-WINDOW ATTRACTION.

A moving thing in a window is reasonably sure to get a crowd, and it is easy for an electrical dealer to have motion in the windows, says *The Electrical Dealer and Contractor*, and a very good means of providing motion in a window is by means of an electric fan, a small box and a lot of twine. This is illustrated herewith.



Effective Show-Window Attraction—Fan Blows Balloons Upward Continuously.

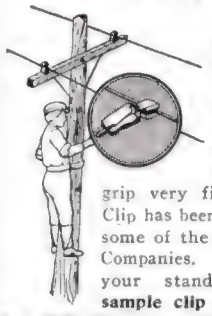
The drawing shows very plainly how the plan is worked. Lay an electric fan on its back in a small box. Then tie a lot of strings on the box extending them up to a barrel hoop fastened to the top of the background. Inside of the strings put four or five toy balloons. Then start the fan. The balloons will bob up and down and the people will stop and look. They can't help it. They cannot see the fan, and this will give the impression that the balloons are being propelled by some mysterious force.

One merchant who tried this plan painted a letter on each balloon. Together they represented some word. He advertised that he would give a prize to the person who guessed the word. It seemed to him that nearly everybody in town tried to patch the word together from the letters on the balloons as they bobbed up and down with rhythmic regularity.

Try the plan. It is about the easiest and most inexpensive means of supplying attractive motion in windows that has come to our attention in a long time.

Do you realize that, with this issue of 64 pages, at 10 cents, the ELECTRICAL EXPERIMENTER contains the equivalent of 128 pages of ordinary magazine size! It is equal in value to a $2.00 text-book. Don't miss the October number!

Lineman's Test Clips



Universal Test Clips are ideal for the lineman. Because—They make sure contact, fit the hand, never slip, have a very high capacity yet fit in very small places. Side teeth grip very fine wire. Our No. 8 Clip has been adopted as standard by some of the largest Bell Telephone Companies. Make Universal Clips your standard. **Send 15c. for sample clip and complete catalog.**

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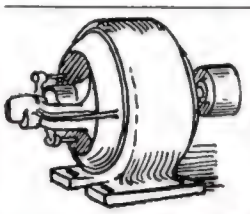

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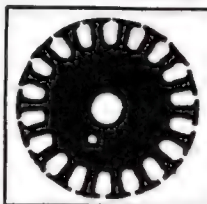

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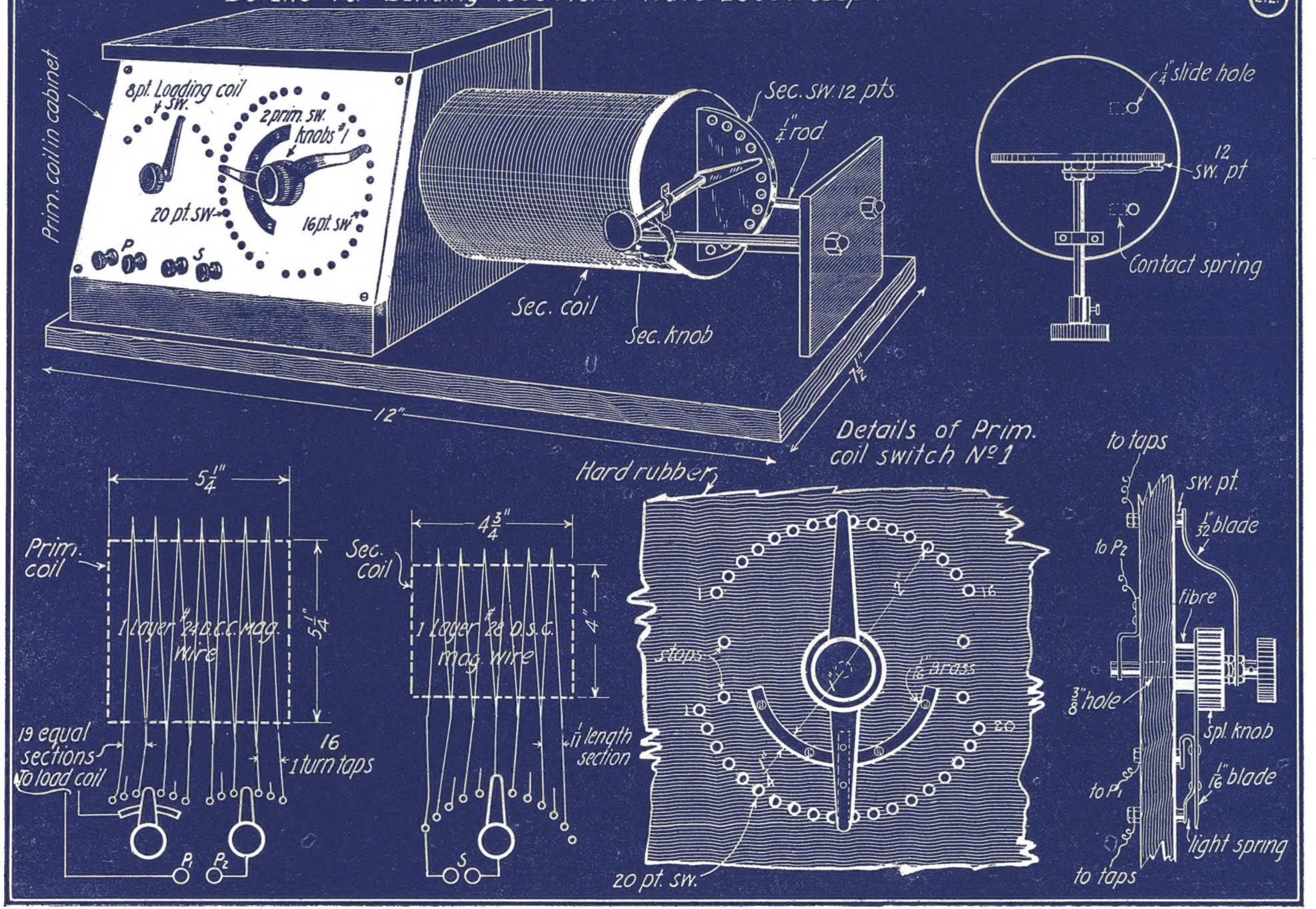

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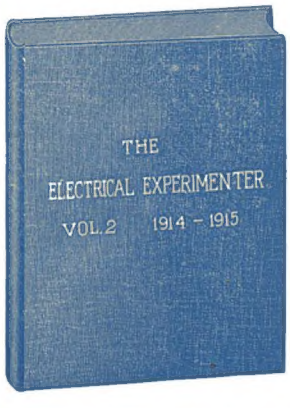

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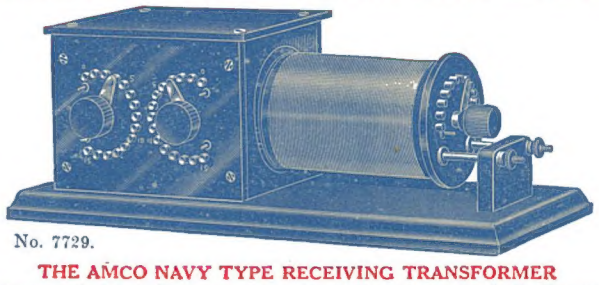

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